SOUTHEASTERN MICHIGAN WATER RESOURCES STUDY

AGRICULTURE APPENDIX

August 1975

UNITED STATES DEPARTMENT OF AGRICULTURE
ECONOMIC RESEARCH SERVICE - FOREST SERVICE
SOIL CONSERVATION SERVICE

In cooperation with: The U. S. Army Engineer District, Detroit,
Corps of Engineers

USDA-SCS-LINCOLN, NEBR. 1974

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Economic Research Service
Forest Service
U.S. Soil Conservation Service

In cooperation with the

Department of the Army, Corps of Engineers
Detroit District

PREFACE

As originally planned, the Southeastern Michigan Study Report was to consist of a Main Report with Appendices to support it. The study was to have been completed in 1973 and the reports published. Work was suspended until further notice because of a change in priorities for the Army Corps of Engineers, the study leaders. Timeliness of the data collected by the U.S. Department of Agriculture made it imperative that this data be made available as soon as possible. As a result, the Agriculture Appendix has been prepared to transmit that information to Federal agencies, local governments, and interested citizens. When the study resumes, the information also can be used by the coordinating committee to develop the comprehensive plan to meet the projected long-range needs of the region.

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SUMMARY

This report was prepared by the U.S. Department of Agriculture to assist local planners and decision-makers in the development and efficient use of the water and related land resources in the Southeastern Michigan Study Area.

The Study Area encompasses a 5,301-square-mile area drained by the Michigan streams that discharge into the St. Clair River, Lake St. Clair, the Detroit River, and Lake Erie. Some 5 million people, over half of the State's population, reside within the Study Area. About 60 percent of the Study Area is cropland and pasture, 17 percent is urban, and 16 percent is forest land. The remaining 7 percent includes rural roads, water, and other uses.

By 2020, the land use is expected to be 38 percent cropland and pasture, 42 percent urban, 13 percent forest land, and 7 percent rural roads, water, and other uses.

The primary objective of this report is to present information that will improve and strengthen area land use planning. This will include water and land resource data, an analysis of problems associated with the present and future use of water and land resources, and the development of alternative solutions to these problems.

Problems

1. Idle cropland is projected to decrease from some 660,000 acres to 20,000 acres during the next 50 years, unless land use trends are changed. This land now provides wildlife habitat and recreation areas, in addition to benefiting the environmental quality of the rural landscape.

2. Urban development will diminish the prime agricultural land and prime recreational land resources unless land use controls are enacted.

3. Unless future urban growth is carefully planned, the projected development of 866,000 acres will have a devastating impact on the environment of southeastern Michigan. The most serious environmental problem in a poorly planned urban area is the stark urban landscape.

4. Timber production from commercial forest land is decreasing due to urban sprawl, the increase in rural summer home development, and poor timber management.

5. Fish and wildlife habitat is deteriorating due to land use changes, maximum open space farming, and loss of streambank vegetation.

6. Existing and potential flooding problems are identified in 31 locations. Scattered-to-dense urban development is subject to flooding along 77 miles of streams. Urban development is expected to take place along 106 miles of streams because of proximity to existing urban areas. Present average annual flooding is estimated at $1,600,000. Future average annual damage is expected to be $5,100,000, unless development is restricted in the flood plains. Periodic flooding is a problem on 19,100 acres of cropland, causing $1,268,000 of average annual damage.

7. There are approximately 887,200 acres of wet cropland and pasture. Some 330,000 acres of this land are classified as prime agricultural land. Wet cropland results in a lower quality crop, reduced yields, higher production costs, and inefficient use of land, labor, and capital.

8. Sheet erosion (the removal of a fairly uniform layer of soil from the land surface by runoff water) is the most extensive and critical erosion problem in the rural areas. Approximately 7,500,000 tons of soil are eroded annually due to sheet erosion. In the urban areas, erosion on construction sites is the most critical type of erosion. Soil erosion on construction sites amounts to approximately 1,200,000 tons annually.

9. Sediment deposition causes a variety of problems in the Study Area. Sediment destroys fish habitat, reduces channel and reservoir capacity, and carries nutrients, pesticides, bacteria, and other contaminants. Almost 900,000 tons of sediment pass through the streams in the region annually.

USDA Recommendations

1. The one-half million acres of prime cropland should be retained for agricultural use. The 280,000 acres of wet prime cropland should be drained by the year 2020. If both are accomplished, over 200,000 acres less land will be required to produce the food demands in 2020 than would otherwise be necessary.

   The going rate of drainage will drain approximately 175,000 acres by 2020. The recommended additional drainage would cost approximately $60,000,000 to install, plus an additional $3,000,000 for 150 man-years of technical assistance.

2. Accelerate the soil survey program in Monroe and Oakland Counties to complete the surveys by 1985. To map the remaining 720,000 acres, 24 additional man-years of soil scientist's work will be required costing approximately $500,000. Soil surveys are completed in all the other counties in the Study Area.

3. Develop an urban and community forestry program to provide, protect, restore and enhance all urban environmental values that are dependent upon the culture of trees. To accomplish this a forester position should be created at both Ann Arbor and Pontiac by the Michigan Department of Natural Resources, to provide landowners technical assistance in managing 68,000 acres of forest land.

4. Promote growth into the sawtimber size classes through selective removals in the overstocked, hardwood poletimber stands. The most effective way to accomplish this end is to find new markets for this poletimber material, through a forest products utilization study of the rural areas of the region. To find new markets, a detailed forest product utilization study is recommended which would determine what is available and where.

5. Accelerate the land treatment program on 8,200 acres of commercial forest land in Subarea 1 to bring this land into full timber production. Approximately 10 man-years of technical assistance, costing $200,000 would be required. The treatment application cost is estimated to be $239,000.

6. Maintain and manage streambank vegetation to protect the quality fish streams in the region through the establishment of buffer zones fifty feet wide along the main-streams and 20-foot zones along the tributary streams and agricultural drains.

7. Manage county road and railroad rights-of-way for wildlife habitat where suitable.

8. Obtain a County Scenic Rivers designation under the Natural River Act of 1970 for the Black River in Sanilac County and portions of the Clinton River in Macomb County.

9. Flood plain land use controls are recommended for 27 urban locations in the Study Area. It is estimated that flood plain management can reduce future average annual urban flood damages by approximately $3,820,000. Part of this recommendation should include flood plain delineation. Assistance is available through the Soil Conservation Service's Flood Hazard Analyses Program. The Federal cost of this work would be approximately $366,000.

10. To reduce flooding and improve drainage outlets structural projects should be developed in five watersheds--North Branch Clinton River, Tupper Brook, Otter Creek, Elk Creek, and Upper Belle River. The total estimated installation cost of these projects is about $21,500,000. These projects are estimated to produce average annual benefits of $2,390,000 at an average annual cost of $1,396,000.

11. Make a detailed study of the ground water pollution problem in northeast Whiteford Township, Monroe County. Preliminary surveys indicate that a surface drainage outlet would be physically feasible.

12. Accelerate the land treatment program by adequately treating 80,000 acres of moderately to highly erosive land used for rowcrops in Subarea 4 and 5. This treatment should be applied during the next 10 years. Approximately 17 man-years of technical assistance, costing $350,000 would be required. The cost of applying the land treatment would be $1,300,000. With adequate treatment erosion would be reduced 578,000 tons annually.

13. Support the Soil Erosion and Sediment Control Act of 1972, to reduce erosion on construction sites. With over 15,000 acres converting to urban use each year, erosion can be reduced by up to 900,000 tons annually with proper land treatment. Land treatment costs vary from $400 to $1,000 per acre. Application costs would be about $9,000,000 each year and technical assistance about $1,000,000 annually for 50 man-years of work.

CHAPTER I

Introduction

CHAPTER I

INTRODUCTION

As a direct result of the legislation creating the Appalachia Region Study, several people felt that a regional approach to water and related land resource planning might be a good concept to follow. This was a break from the traditional watershed or river basin concept which was being followed at that time. Senator Patrick McNamara became interested and felt that the southeastern Michigan area might be a good location to try out this concept.

Legislation drafted and passed in October 1965 called for the preparation of a "comprehensive plan for the development and efficient utilization of water and related resources of the region." It further states

> Said comprehensive plan shall be designed to meet the long-range needs of the region for protection against floods, wise use of flood plain lands, improvement of navigation facilities, water supplies for industrial and municipal purposes, outdoor recreation facilities, enhancement and control of water quality, and related purposes; all with the view to encouraging and supporting the optimum long-range economic development of the region and enhancing the welfare of its people.

A coordinating committee was formed, consisting of Federal, State, and local representatives, with the Corps of Engineers serving as chairman. Under the leadership of the Corps, the study began by setting forth the jobs and deciding who would be responsible for carrying them out. The U.S. Department of Agriculture was officially invited to take part in the study as a working partner in 1967.

STUDY OBJECTIVES

The primary objective of this report is to present information that will improve and strengthen area land use planning. This will

include water and land resource data, an analysis of problems associated with the present and future use of these resources, and the development of alternative solutions to these problems.

The study was designed to achieve specific objectives. A review of these objectives will facilitate the use of this report.

1. Identify land uniquely suited for agricultural and recreational use.

2. Provide a better understanding of forest land management problems throughout the region by analyzing the forest resource. Identify areas where the urbanizing environment can be protected and enhanced by an urban forestry program.

3. Identify present and potential land use conflicts between agriculture, forestry, urban development, and preservation and management of fish and wildlife habitat. Explore ways the land can be used in harmony with the fish and wildlife.

4. Analyze the impacts of suspended sediment on the water quality of the major watercourses.

5. Identify those flood plains with significant existing or potential flooding problems. Provide information that will assist local planners in determining proper land use and in carrying out flood plain management programs.

6. Analyze the use of drainage as a means of reducing the amount of cropland required to produce the projected food and fiber demands. Identify cropland wetness problems and suggest methods to alleviate those problems in watersheds where project action appears practical.

7. Determine for each soil group the potential erosion rates associated with agriculture and construction site activities. Determine the needed program and the effects of proper land treatment and management.

DESCRIPTION OF STUDY AREA

The study encompassed a 5,301-square-mile area drained by the Michigan streams discharging into the St. Clair River, Lake St. Clair, the Detroit River, and Lake Erie. All or portions of 13 Michigan counties are included (Figure 1-1). An additional 71 square miles in northern Ohio was not studied. Major cities in the Study Area are Metropolitan Detroit, Port Huron, Mount Clemens, Pontiac, Ann Arbor, Ypsilanti, Adrian, and Monroe. Some 5 million people, more than half of the State's population, reside within the Study Area.

Although a large portion of southeastern Michigan is urbanized (17 percent), cropland and pastureland comprise about 60 percent of the area. Due to the proximity of metropolitan markets, truck gardening and dairy farming are important factors in the rural economy. In the southern part of the Study Area, livestock and high value field crops are an important source of farm income. City markets in the central part of the area have encouraged the production of fruit, vegetables, nursery and greenhouse specialities, and milk and poultry products on smaller farms. In the northern part of the area, a major portion of the economic base is dependent on dairy and cash crop farming.

Approximately 16 percent of the area is forest land. Forest products, forest-based employment, and forest recreational activities contribute to the overall economy. Other land (including farm roads, farmsteads, utilities, and cemeteries) comprises 6 percent of the area, and water surfaces comprise 1 percent.

To facilitate resource analysis, the Study Area (sometimes referred to as the basin) was divided into five hydrologic subareas (also called subbasins). Subarea 1 includes the Black, Pine, and Belle River Basins. Subarea 2 is the Clinton River Basin. Subarea 3 includes the River Rouge Basin, Subarea 4 includes the River Raisin Basin, and Subarea 5 is the Huron River Basin.

USDA AGENCY RESPONSIBILITIES

As part of the overall comprehensive study team, the Department was assigned to survey, study, and evaluate the agricultural and forestry resources of the area. This included making studies and projections of agricultural economic development for the years 1980, 2000, and 2020; determining needs for water and related land resources development; making a general appraisal of water availability (quantity and quality); appraising of related land resource availability; identifying and studying upstream areas with potential for flood damage; and making an inventory of potential upstream reservoir sites. Specific responsibilities of each agency are summarized below.

Soil Conservation Service

The Soil Conservation Service has overall responsibility for the U.S. Department of Agriculture study activities, and specific responsibility for the following:

1. Providing the chairman of the Field Advisory Committee.

2. Providing the chairman of the Sediment and Erosion Work Group.

3. Providing the cochairman of the Management of Floodwaters Flood Plains Work Group.

4. Providing the chairman of the Drainage and Irrigation Work Group.

5. Providing the chairman of the Land Use and Management Work Group.

6. Making physical appraisals of agricultural and rural water problems.

7. Determining development potentials, including the physical and economic feasibility of watershed projects.

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

HURON CO.

SANILAC CO.

BLACK RIVER BASIN

LAPEER CO.

ST. CLAIR CO.

JOINS UPPER RIGHT

PORT HURON

JOINS LOWER LEFT

LAPEER CO.

BELLE RIVER BASIN

ST. CLAIR CO.

PINE RIVER BASIN

PORT HURON

MACOMB CO.

CLINTON RIVER BASIN

PONTIAC

INGHAM CO.

OAKLAND CO.

LIVINGSTON CO.

MT. CLEMENS

LAKE ST CLAIR

RIVER ROUGE BASIN

HURON RIVER BASIN

ANN ARBOR

DETROIT

WASHTENAW CO.

JACKSON CO.

YPSILANTI

WAYNE CO.

DETROIT RIVER

HILLSDALE CO.

LENAWEE CO.

ADRIAN

RIVER RAISIN BASIN

MONROE

MONROE CO.

LAKE ERIE

FULTON CO.

MICHIGAN

OHIO

MICHIGAN UNITED STATES CANADA ONTARIO

MICHIGAN UNITED STATES CANADA ONTARIO

N

LEGEND

STATE LINE
COUNTY LINE
STREAM, LARGE
STREAM, SMALL
LAKE
HIGHWAY, INTERSTATE
HIGHWAY, U.S.
HIGHWAY, STATE
OTHER HIGHWAYS
CITY BOUNDARY
BASIN BOUNDARY
STUDY AREA BOUNDARY
SUBAREA BOUNDARY

SCALE 1/615,150

SCALE 1 0 1 2 3 4 5 6 7 8 9 MILES

FIGURE 1-1

SOUTHEASTERN MICHIGAN WATER RESOURCES STUDY

MICHIGAN

MAP OF STUDY AREA

U.S. DEPARTMENT OF AGRICULTURE

Economic Research Service, Forest Service and Soil Conservation Service

S.R-31,919-1

SOURCE:
S.R-25,755 AND DATA FURNISHED BY FIELD OFFICES LINCOLN NEBR. 1970

POLYCONIC PROJECTION

8. Evaluating the physical, economic, and environmental effects of the plans, programs, and projects of the river basins, and coordinating them with the proposals of other departments through plan formulation.

9. Providing U.S. Department of Agriculture leadership in plan formulation.

Forest Service

The Forest Service has the responsibility for the following:

1. Analyzing the forest resource sector of the economy, including projections of volume and value of timber production, income and employment in forestry activities, and use of forest land for improved water management, timber production, recreation, wildlife, and environmental quality.

2. Translating such projections into needs for water and related forest land.

3. Participating with the Soil Conservation Service and the Economic Research Service in appraising related forest land availability.

4. Determining present and future forest cover conditions as they relate to the water resource.

5. Determining problems and land treatment needs of forested lands.

6. Collaborating with the Bureau of Outdoor Recreation, the Economic Research Service, the Soil Conservation Service, and the State to identify opportunities and potentials for outdoor recreation in public and large privately owned forested areas not otherwise included.

7. Determining the environmental impact of proposed drainage, channelization, land use changes, and structural and other developments of the forest resources.

8. Providing a member to the following work groups: Sediment and Erosion, Economic and Demographic, Management of Floodwater-Flood Plains, Drainage and Irrigation, Land Use and Management, Recreation, and Environmental Quality. Assistance will also be provided in developing the plan formulation criteria.

Economic Research Service

The Economic Research Service is responsible for the following:

1. Making the economic base survey.

    a. Analysis and projection of (1) economic activity in the agricultural and related sectors of the economy, and (2) the demand for land and water resources in such activities.

    b. Assessment of the current and projected demands for goods and services obtainable from the use of water and related land resources and the translation of such demands into economic needs for development.

2. Making studies of problems and needs.

    a. Analysis of agricultural and rural water problems as they relate to economic activity in rural areas, and specifically to the volume and value of production, employment, and income.

    b. Economic appraisal of agricultural and rural needs for water and related land resource development.

3. Making impact studies and determining secondary effects. Appraisal of prospective economic impact of development alternatives defined by the study on the agricultural, rural, and related sectors of the economy and the economic relationship of these alternatives to the coordinated and comprehensive development of the area.

4. Providing consultive services to the Soil Conservation Service and the Forest Service in developing and applying standards and procedures for assessing the economic feasibility of watershed developments.

AUTHORITY FOR THE STUDY

Section 206 of Public Law 298, 89th Congress, enacted October 27, 1965, authorized the Secretary of Army to prepare, under the direction of the Chief of Engineers, a comprehensive plan for the development and efficient use of the water and related resources of the Southeastern Michigan Water Resource Area. In October 1966, the Detroit District, U.S. Army Corps of Engineers, requested that the U.S. Department of Agriculture participate in this study along with other Federal, State, and local agencies. As a result of this request, the Department of Agriculture authorized the initiation of a Type 4 cooperative study in November 1967, under Section 6 of the Public Law 83-566, the Watershed Protection and Flood Prevention Act, as amended.

RESPONSIBILITES OF SPONSORING AND COOPERATING AGENCIES

Many agencies have taken part in the study, and all have assisted in providing information that will adequately describe the existing situation, in identifying problems, and in recommending alternative solutions to these problems. Participating Federal agencies include the U.S. Department of Commerce, National Oceanic and Atmospheric Administration; the U.S. Department of Housing and Urban Development; the U.S. Department of the Interior, including the Geological Survey, Bureau of Mines, Bureau of Outdoor Recreation, and Fish and Wildlife Service; the U.S. Department of Health, Education and Welfare, Public Health Service; and the U.S. Environmental Protection Agency. Participating agencies of the State of Michigan include the Department of Agriculture, the Department of Commerce, the Department of Natural Resources, the Department of Public Health, the Waterways Commission, and the Natural Resources Commission.

The Coordinating Committee decided to prepare a main report with 20 appendices. Table 1-1 lists the appendices and the agency responsible for each.

TABLE 1-1--Tentative Report Assignments

ITEM	SUBJECT	RESPONSIBLE FEDERAL AGENCIES
	Main Report	CORPS
Appendix	A - History of Investigation	CORPS
	B - Description of Area	CORPS
	C - Climate and Meteorology	CORPS/NOAA
	D - Geology and Groundwater	USGS
	E - Mineral Resource	BOM
	F - Surface Water and Hydrology	CORPS/USGS
	G - Sediment and Erosion	USDA
	H - Economic and Demographic	CORPS/USDA
	I - Management of Floodwaters-Flood Plains	CORPS/USDA
	J - Navigation	CORPS
	K - Drainage and Irrigation	USDA
	L - Land Use and Management	USDA
	M - Water Supply	EPA/PHS
	N - Water Quality	EPA
	O - Health Aspects	PHS
	P - Recreation	BOR
	Q - Fish and Wildlife	F&WS
	R - Federal and State Policies	CORPS & STATE OF MICHIGAN
	S - Plan Formulation Criteria	ALL
	T - Plan of Development	ALL

CHAPTER II

Natural Resources of the Region

CHAPTER II

NATURAL RESOURCES OF THE REGION

LOCATION

Located in the southeastern corner of Michigan's lower peninsula, the Study Area is bounded on the northwest by the Saginaw River Basin, on the northeast by small tributaries of Lake Huron, on the west by the Grand River Basin, on the south by the Maumee River Basin and the Ohio State line, and on the east by the St. Clair River, Lake St. Clair, the Detroit River, and Lake Erie.

CLIMATE

Southeastern Michigan's climate is moderated by the Great Lakes. Average yearly temperatures vary from 47°F at Port Huron to 50°F at Monroe, with extreme fluctuations of short durations ranging from 108°F to -26°F. Precipitation averages 31 inches annually. The total annual snowfall varies from about 42 inches at Port Huron to about 30 inches at Monroe.

Climatic conditions normally do not impose a severe restraint upon agricultural production, although frost damage in the spring and fall and short periods of droughtiness during the growing season are not uncommon. The average frost-free season is from May 17 to October 6 in the north and from May 5 to October 10 in the south.

PHYSICAL DESCRIPTION

Land Use

The major land use in the 34-million-acre Study Area is cropland, which comprises 1.9 million acres (57 percent) of the Study Area, as shown in Table 2-1. Cropland is most extensive in the northern and southern subareas. Urban use is second, with 510,200 acres (17 percent), and is mainly concentrated in Subareas 2 and 3, which contain the City of Detroit. Forest land, with 546,600 acres (10 percent), is followed by other land (farmsteads, rural roads, etc.), 214,500 acres (6 percent); pastureland, 93,200 acres (4 percent); and water area, 49,600 acres (1 percent).

TABLE 2-1--Present Land Use by Subarea

Land Use	Subarea 1	2	3	4	5	Region Total
	1,000 Acres					
Cropland[1]	606.8	224.9	63.4	750.6	272.7	1,918.4
Pasture	31.2	9.6	.9	23.3	28.2	93.2
Forest	130.1	74.0	59.4	133.1	150.0	546.6
(Parks & Game Areas)	(2.0)	(7.0)	(4.0)	(7.0)	(36.0)	(56.0)
Urban	33.1	131.9	303.2	53.8	48.2	570.2
Water	1.0	11.8	3.0	7.2	26.6	49.6
Other	36.8	34.2	34.7	53.4	55.4	214.5
(Rural transportation)	(23.0)	(19.9)	(15.2)	(23.4)	(23.6)	(105.1)
TOTAL	839.0	486.4	464.6	1,021.4	581.1	3,392.5

[1]Includes active and idle cropland.

Geology

Glacial activities gave the Study Area its present surface configuration. Two distinct surface land forms were created. The western part, or the upstream portion of the area, is primarily hilly and rolling upland with local gently sloping to flat areas. This area is formed of glacial moraines, till plains, and outwash deposits. The eastern half, or the downstream portion, is flat lakebed deposits formed by ancient glacial lakes (Figure 2-1). The glacial materials range up to several hundred feet in thickness.

Bedrock of the area is sedimentary in origin and is composed of limestone, sandstone, and shale formations, which dip gently to the west. The topography on the bedrock surface and its composition controlled somewhat the nature of the overlying glacial deposits.

Mineral resources are varied and of considerable value. They include petroleum and natural gas, rock salt, brines, crushed stone, clay, shale, peat, sand, and gravel. Information on mineral resources is contained in the Mineral Resources Appendix, prepared by the U.S. Department of the Interior, Bureau of Mines.

Approximately 5,150 natural and man-made lakes enhance the area. The majority of the lakes are in the western part of the area.

Soils

The soils in the Study Area are all of glacially related origin. The upland soils are developed primarily in clay drift or sand and gravel. The lake plain soils are predominantly clay, silt, or fine sands. For regional planning, the soils are placed into soil resource groups according to texture, crop suitability, and problems such as wetness and flood hazard (Figure 2-2).

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

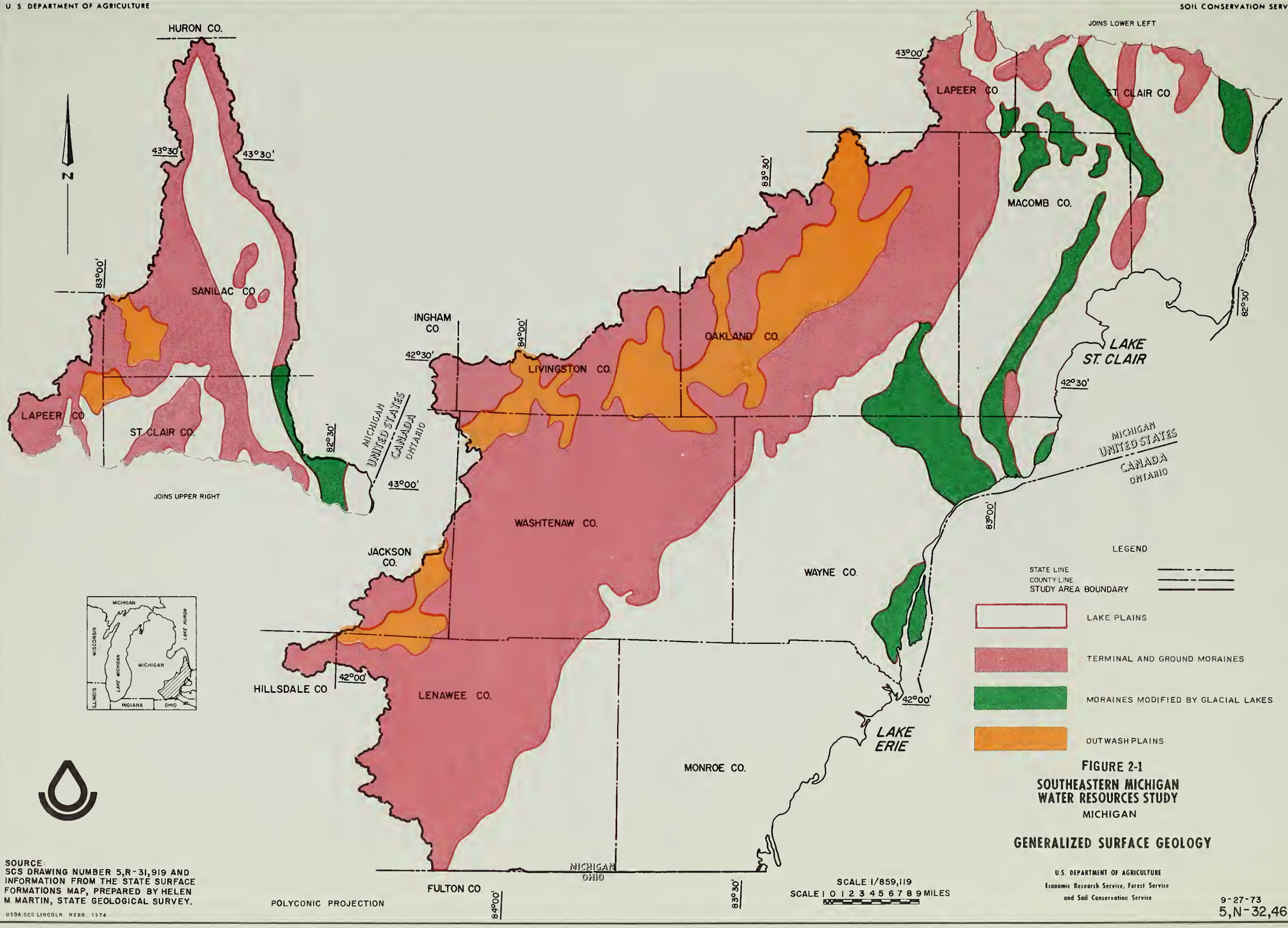


FIGURE 2-1

SOUTHEASTERN MICHIGAN WATER RESOURCES STUDY

MICHIGAN

GENERALIZED SURFACE GEOLOGY

SOURCE:
SCS DRAWING NUMBER 5,R-31,919 AND INFORMATION FROM THE STATE SURFACE FORMATIONS MAP, PREPARED BY HELEN M. MARTIN, STATE GEOLOGICAL SURVEY.

USDA-SCS-LINCOLN, NEBR. 1974

POLYCONIC PROJECTION

SCALE 1/859,119

SCALE 1 0 1 2 3 4 5 6 7 8 9 MILES

U.S. DEPARTMENT OF AGRICULTURE
Economic Research Service, Forest Service
and Soil Conservation Service

9-27-73

5,N-32,466

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

HURON CO.

SANILAC CO.

BLACK RIVER BASIN

LAPEER CO.

ST. CLAIR CO.

JOINS UPPER RIGHT

MICHIGAN
UNITED STATES
CANADA
ONTARIO

JOINS LOWER LEFT

LAPEER CO.

BELLE RIVER BASIN

ST. CLAIR CO.

PINE RIVER BASIN

MACOMB CO.

CLINTON RIVER BASIN

LAKE ST. CLAIR

INGHAM CO.

OAKLAND CO.

LIVINGSTON CO.

HURON RIVER BASIN

RIVER ROUGE BASIN

WASHTENAW CO.

JACKSON CO.

WAYNE CO.

HILLSDALE CO.

LENAWEE CO.

RIVER RAISIN BASIN

MONROE CO.

LAKE ERIE

FULTON CO.

MICHIGAN
OHIO

N

SCALE 1/615,150

SCALE 1 0 1 2 3 4 5 6 7 8 9 MILES

LEGEND

STATE LINE
COUNTY LINE
BASIN BOUNDARY
STUDY AREA BOUNDARY
SUBAREA BOUNDARY

1 WELL TO MODERATELY WELL-DRAINED, MODERATELY FINE AND MEDIUM TEXTURED SOILS

2 WELL-DRAINED SOILS WITH MODERATELY COARSE TO MEDIUM TEXTURED SURFACE SOILS AND MEDIUM TO MODERATELY FINE TEXTURED SUBSOIL AND COARSE TEXTURED SUBSTRATA

3 WELL-DRAINED, COARSE AND MODERATELY COARSE TEXTURED SOILS, UNDERLAIN BY SAND AND GRAVEL.

9 MODERATELY WELL-DRAINED SOILS WITH MODERATELY FINE TEXTURED SURFACE SOILS AND FINE TEXTURED SUBSOILS. SLOPES ARE PREDOMINATELY 7 TO 18 PERCENT

10 WELL AND MODERATELY WELL-DRAINED, MODERATELY COARSE AND MEDIUM TEXTURED SOILS. SUBSOILS ARE FIRM TO VERY FIRM. SOME SOILS HAVE COARSE TEXTURED SUBSTRATA SLOPES ARE PREDOMINATELY 7 TO 18 PERCENT

11 WELL-DRAINED, COARSE AND MODERATELY COARSE TEXTURED SOILS, UNDERLAIN BY SAND AND GRAVEL. SLOPES ARE PREDOMINATELY 7 TO 18 PERCENT

15 FRESH WATER MARSH AND SWAMPY PEAT LAND.

16 SOMEWHAT POORLY AND POORLY DRAINED, MODERATELY FINE AND MEDIUM TEXTURED SOILS

17 SOMEWHAT POORLY AND POORLY DRAINED, MODERATELY COARSE TEXTURED SOILS

18 SOMEWHAT POORLY AND POORLY DRAINED, MODERATELY FINE TO FINE TEXTURED SURFACE SOILS AND FINE TEXTURED SUBSOILS.

19 SOMEWHAT POORLY AND VERY POORLY DRAINED, MODERATELY COARSE AND COARSE TEXTURED SOILS. MOST ARE UNDERLAIN BY SAND AND GRAVEL.

20 SOMEWHAT POORLY AND VERY POORLY DRAINED, MODERATELY FINE TO MODERATELY COARSE TEXTURED ALLUVIAL SOILS FREQUENTLY FLOODED

21 VERY POORLY DRAINED ORGANIC SOILS (MUCK AND PEATS). SOME INCLUDED ARE UNDERLAIN BY MINERAL MATERIALS AT DEPTHS OF 20 TO 40 INCHES.

MICHIGAN
WISCONSIN
ILLINOIS
INDIANA
OHIO
LAKE MICHIGAN
LAKE HURON

SOUTHEASTERN MICHIGAN WATER RESOURCES STUDY

MICHIGAN

SOIL RESOURCE GROUPS

U.S. DEPARTMENT OF AGRICULTURE
Economic Research Service, Forest Service
and Soil Conservation Service

FIGURE 2-2

SOURCE
SCS DRAWING NUMBER 5,R-31,919 AND
INFORMATION FROM FIELD TECHNICIANS

POLYCONIC PROJECTION

5,R-32,122

Soil resource group characteristics vary primarily in natural internal drainage, permeability, and depth to water table. Natural internal drainage ranges from well drained to very poorly drained, and permeability ranges from very rapid to very slow. Depth to seasonal high water table ranges from 0 to more than 3 feet (Table 2-2 and Appendix A).

Suitability of a soil resource group for a specific use is determined by the degree of soil limitations for that use. Soils are rated for three degrees of soil limitations: slight, relatively free of limitations or with limitations easily overcome; moderate, limitations need to be recognized but can be overcome with good management and careful designs; and severe, limitations are severe enough to make use questionable (Table 2-3).

Agriculture

Twenty-five percent of 518,000 acres of agricultural land is classified as prime (Figures 2-3 and 2-4). This land falls into capability classes I, II, and III and other than this criteria for the prime classification, varies in characteristics and thus is suitable for

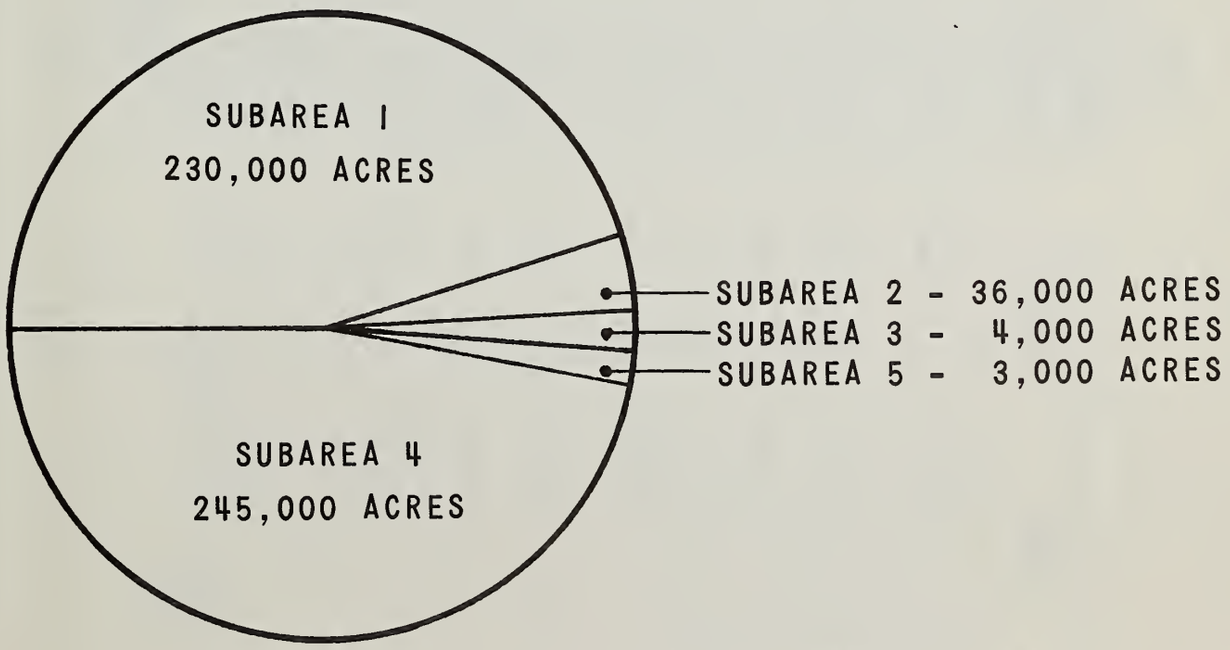


FIGURE 2-3 PRIME AGRICULTURAL LAND BY SUBAREAS

TABLE 2-2--Soil Resource Group Characteristics

Soil Resource Group	Capability Class, and Sub-Class	Percent of Study Area in Soil Resource Group	Drainage Class	Permeability	Depth to Seasonal High Water Table
3	IIe IIe	7.6	Well to Moderately Well	Moderate to Moderately Slow	2-3'+
4	IIe	2.8	Well	Moderate	3'+
7	IIIs IVs	3.8	Well	Rapid to Moderately Rapid	2-3'+
9	IIIe IIIe	3.1	Moderately Well	Slow to Very Slow	2-3'+
10	IIIe IIIe	9.6	Well and Moderately Well	Moderate	2-3'+
12	IIIe VIs	9.8	Well	Moderately Rapid to Very Rapid	3'+
15	VIIIs VIIIw	0.5	Very Poorly	Moderate	0'
16	IIw IIw	33.3	Somewhat Poorly and Poorly	Moderately Slow to Slow	0-2'
17	IIw IIw	8.8	Somewhat Poorly and Poorly	Moderate to Moderately Slow	0-2'
18	IIIw IIIw	4.5	Somewhat Poorly and Poorly	Slow to Very Slow	0-2'
19	IIIw IIIw	10.5	Somewhat Poorly and Very Poorly	Moderately Rapid to Rapid	0-2'
20	IIIw	1.6	Somewhat Poorly and Very Poorly	Moderate to Moderately Rapid	0-2'
21	IIIw IVw	4.1	Very Poorly	Moderately Rapid	0-2'

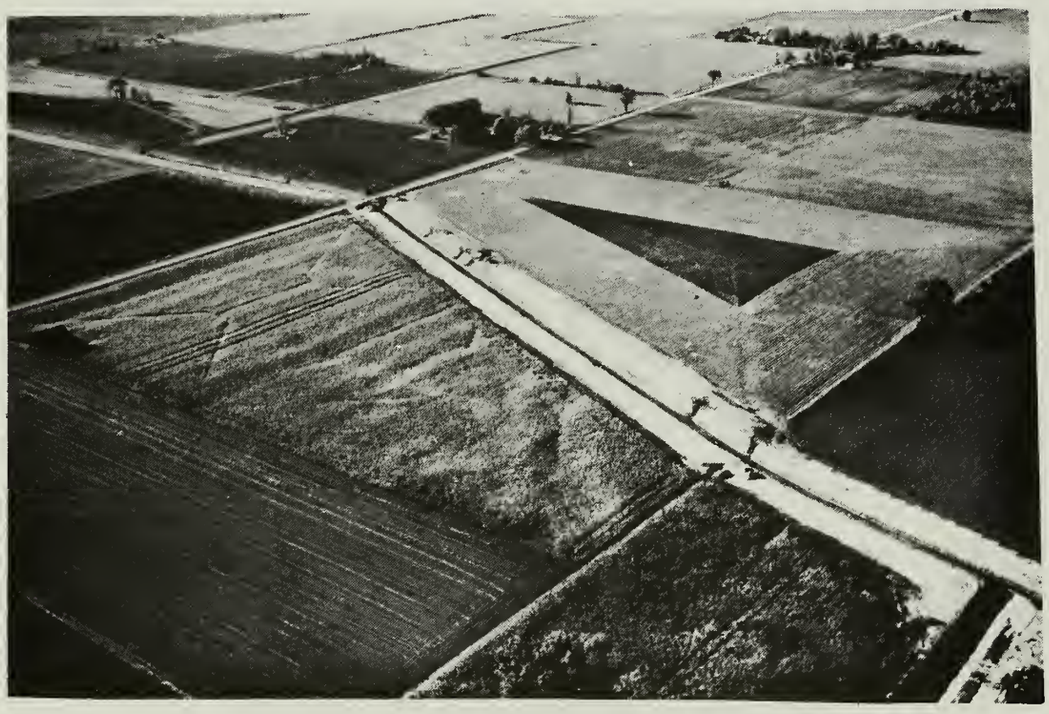
NOTE: Definitions of terms used here are found in Appendix A of this Report.

TABLE 2-3--Soil Resource Group Use Limitations

Soil Resource Group	Agriculture	Forestry	Residential Development		Recreational Development		Wildlife		
			Home Sites	Septic Tanks	Park and Play Areas	Camp Areas and Trailers	Open Land	Wood Land	Wet Land
3	Slight	Slight	Slight to Moderate	Slight to Severe	Slight to Moderate	Slight to Moderate	Slight	Slight	Severe
4	Slight	Slight	Slight	Slight	Slight	Slight	Slight	Slight	Severe
7	Moderate	Moderate	Slight	Slight	Slight	Slight	Slight to Severe	Slight to Severe	Severe
9	Moderate	Slight	Moderate to Severe	Severe	Moderate to Severe	Moderate to Severe	Moderate	Moderate	Severe
10	Moderate	Slight	Slight	Slight to Moderate	Slight	Slight	Slight	Slight	Severe
12	Moderate to Severe	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Severe
15	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Severe	Slight
16	Slight	Moderate	Severe	Severe	Severe	Severe	Slight to Severe	Slight to Severe	Slight to Moderate
17	Slight	Moderate	Moderate	Severe	Severe	Severe	Slight	Slight to Moderate	Slight to Moderate
18	Moderate	Moderate	Severe	Severe	Severe	Severe	Moderate to Severe	Slight	Slight
19	Moderate	Moderate	Moderate to Severe	Severe	Moderate to Severe	Moderate to Severe	Moderate to Severe	Moderate to Severe	Slight to Severe
20	Moderate	Severe	Severe	Severe	Severe	Severe	Slight to Moderate	Moderate	Moderate
21	Moderate	Severe	Severe	Severe	Severe	Severe	Slight to Moderate	Moderate	Moderate

different types of crops. All such land is capable of high yields. For general field crops, such as wheat and corn, the land should be in contiguous areas of 10,000 acres or more for economic production and marketing.

Lands uniquely suited for specialty crops are also classified as prime. These include the market basket soils (drained mucks and peats) producing head lettuce, carrots, onions, and celery. Lands suitable for specialty crops are considered prime because they are scarce. Most of the prime agricultural land is in soil resource groups 16 and 17 and is found in Subareas 1 and 4.



PRIME AGRICULTURAL LAND IN SANILAC COUNTY.

Approximately 64 percent (1,283,800 acres) of the cropland and pastureland in southeastern Michigan is classified as somewhat poorly to very poorly drained. This land is wet much of the year because of the natural internal drainage conditions of the soil. About 30 percent (376,600 acres) of this land has received artificial drainage to improve the natural drainage (Table 2-4).

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

HURON CO.

JOINS LOWER LEFT

PORT HURON

LAPEER CO.

ST. CLAIR CO.

BELLE RIVER BASIN

PINE RIVER BASIN

MACOMB CO.

CLINTON RIVER BASIN

PONTIAC

SANILAC CO.

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INGHAM CO.

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MT. CLEMENS

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LAPEER CO.

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PORT HURON

MICHIGAN UNITED STATES CANADA ONTARIO

HURON RIVER BASIN

RIVER ROUGE BASIN

ANN ARBOR

DETROIT

WASHTENAW CO.

JACKSON CO.

YPSILANTI

WAYNE CO.

DETROIT RIVER

HILLSDALE CO.

LENAWEE CO.

ADRIAN

RIVER RAISIN BASIN

MONROE

MONROE CO.

LAKE ERIE

MICHIGAN OHIO

FULTON CO.

N

LEGEND

- STATE LINE
- COUNTY LINE
- STREAM, LARGE
- STREAM, SMALL
- LAKE
- HIGHWAY, INTERSTATE
- HIGHWAY, U S
- HIGHWAY, STATE
- OTHER HIGHWAYS
- CITY BOUNDARY
- BASIN BOUNDARY
- STUDY AREA BOUNDARY
- SUBAREA BOUNDARY
- AGRICULTURE
- RECREATION

SCALE 1/615,150

SCALE I 0 1 2 3 4 5 6 7 8 9 MILES

SOURCE
SCS DRAWING NUMBER S,R-31,911 AND INFORMATION FROM FIELD TECHNICIANS

POLYCONIC PROJECTION

FIGURE 2-4

SOUTHEASTERN MICHIGAN WATER RESOURCES STUDY

MICHIGAN

PRIME AGRICULTURE AND RECREATION LAND

U.S. DEPARTMENT OF AGRICULTURE
Economic Research Service, Forest Service and Soil Conservation Service

S 22-75
S,R-32,116

TABLE 2-4--Wet Cropland and Pasture

Sub-Area	Undrained Wet Cropland	Undrained Wet Pasture	Total Undrained Wet Cropland and Pasture	Drained Wet Cropland and Pasture	Total Drained and Undrained Wet Cropland and Pasture
	----------Acres----------				
1	422,500	19,200	441,700	87,300	529,000
2	68,900	2,500	71,400	45,100	116,500
3	20,500	700	21,200	21,700	42,900
4	291,500	6,000	297,500	213,200	510,700
5	48,800	6,600	55,400	29,300	84,700
TOTAL	852,200	35,000	887,200	396,600	1,283,800

The more than 887,200 acres remaining represent a valuable resource with the potential for increased production with proper drainage measures. Most of this wet cropland and pastureland is in the lake plain area (Figure 2-2). Approximately 86 percent of it is in Subareas 1 and 4.

In their natural condition, soil resource groups 16 through 21 are inadequately drained for optimum crop production. If adequately drained, the potential crop yield increases for these groups would range from 55 to 85 percent (Table 2-5).

Forest

The area encompassed by the Southeastern Michigan Water Resources Study includes approximately 16 percent forested lands, or 546,600 acres (Table 2-6). Ninety-six percent of this is considered commercial,

i.e., land that is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation.

TABLE 2-5--Potential Crop Yield Increase with Adequate Drainage

Soil Resource Group	Percent Crop Yield Increase
16	80
17	55
18	70
19	65
20	85
21	70

TABLE 2-6--Forest Land by Subarea

Subarea	Percent Forested	Total	Commercial	Noncommercial
		Acres		
1	16	130.1	129.0	1.1
2	15	74.0	55.1	18.9
3	13	59.4	57.8	1.6
4	13	133.1	132.1	1.0
5	26	150.0	148.2	1.8
TOTAL	16	546.6	522.2	24.4

Major forest types are oak-hickory (200,400 acres), elm-ash-cottonwood (56,500 acres), maple-beech-white birch (110,000 acres), and aspen-birch (104,200 acres). Distribution of these types are shown in Figure 2-5. In addition, there are 51,100 acres of pine and spruce fir in the Study Area. A more detailed breakdown by subbasins can be found in Appendix C, Table C-1.

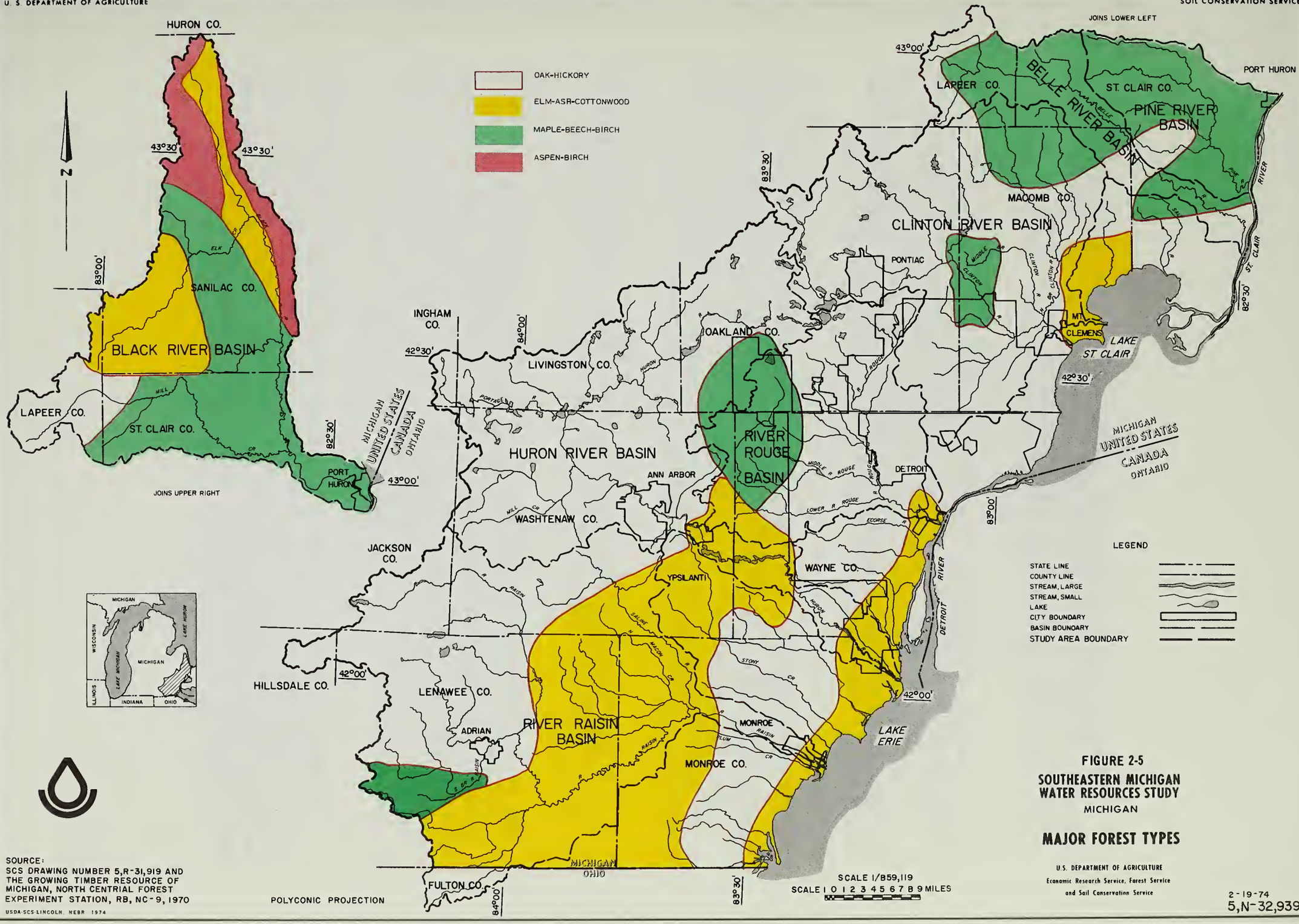
Acres in the sawtimber size class have decreased by about 7 percent since 1955 and presently 33 percent of the forested lands are in this size class. Recent heavy cuttings in sawtimber size class have resulted in a 4 percent acreage increase in the seedling-sapling and nonstocked stands. At present, 34 percent of the total forest acreage is occupied by seedlings and saplings and 10 percent is considered nonstocked. Poletimber acreage has remained relatively stable at 23 percent.

There are approximately 418 million cubic feet of growing stock on commercial forest land within the Study Area, including 191.7 million cubic feet in sawtimber.

Stocking, the degree of utilization of land by trees as measured in terms of the number of trees required to fully utilize the growth potential of the land, is given by classes. In southeastern Michigan there are 311,600 acres in a stocking class of over 40 percent, 154,800 acres in the class of 10-40 percent, and 55,800 in a class which is less than 10 percent. Appendix C, Table C-2 gives a further breakdown of this data.

Over 91 percent of the forest land in the Study Area is in private ownership. This resource of more than 496,000 acres varies in size from small plots on farms to large acreages held by a variety of owners. The 50,000 acres of public owned forest land include 35,600 acres owned by the State, 14,700 acres by county and local governments, and 100 acres by the Federal government. A breakdown by subbasins can be found in Appendix C, Table C-3.

The type and location of existing forested lands are largely determined by the physical characteristics of the soils upon which they grow. An analysis of soils data as it relates to the culture of trees is a prerequisite for determining the potential uses for forestry purposes.


U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
OAK-HICKORY
ELM-ASH-COTTONWOOD
MAPLE-BEECH-BIRCH
ASPEN-BIRCH
HURON CO.
SANILAC CO.
BLACK RIVER BASIN
LAPEER CO.
ST. CLAIR CO.
JOINS UPPER RIGHT
JOINS LOWER LEFT
PORT HURON
BELLE RIVER BASIN
PINE RIVER BASIN
MACOMB CO.
CLINTON RIVER BASIN
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HILLSDALE CO.
LENAWEE CO.
ADRIAN
RIVER RAISIN BASIN
MONROE
MONROE CO.
LAKE ERIE
FULTON CO.
MICHIGAN
UNITED STATES
CANADA
ONTARIO
OHIO
LEGEND
STATE LINE
COUNTY LINE
STREAM, LARGE
STREAM, SMALL
LAKE
CITY BOUNDARY
BASIN BOUNDARY
STUDY AREA BOUNDARY
SCALE 1/859,119
SCALE 1 0 1 2 3 4 5 6 7 8 9 MILES
POLYCONIC PROJECTION
FIGURE 2-5
SOUTHEASTERN MICHIGAN WATER RESOURCES STUDY
MICHIGAN
MAJOR FOREST TYPES
U.S. DEPARTMENT OF AGRICULTURE
Economic Research Service, Forest Service and Soil Conservation Service
2-19-74
5,N-32,939
SOURCE:
SCS DRAWING NUMBER 5,R-31,919 AND THE GROWING TIMBER RESOURCE OF MICHIGAN, NORTH CENTRIAL FOREST EXPERIMENT STATION, RB, NC-9, 1970
USDA-SCS-LINCOLN, NEBR 1974

Forest Land Suitability Categories were developed for the Study Area based on soil associations. The categories are merely an expression of the suitability of the soils for forestry purposes. Five categories have been established and include Category 1--suitable for commercial production, Category 2--suitable for recreational purposes, Category 3--suitable for environmental enhancement, open spaces and greenbelts, Category 4--suitable for upland wildlife habitat, aesthetics, and open space, and Category 5--wetland wildlife habitat, aesthetics, and environmental enhancement. A more detailed description of the categories is found in Appendix C.

Location and extent of the various classes are shown in Figure 2-6. As shown on the map, there are 304,600 acres in Category 1, 361,900 acres in Category 2, 1,628,900 acres in Category 3, 228,400 acres in Category 4, and 252,000 acres in Category 5. A further breakdown is found in Appendix C, Table C-4.

An analysis by subarea reflects the current major forest land uses and describes projected impacts upon the resource.

The most densely forested areas in Subarea 1 are centered around the small towns of Capac, Avoca, and Yale in the center of the subarea. Soils in Forest Land Suitability Category 3 are dominant in the area.

Several large State game areas are located within the subarea. These areas are located principally on soils in Forest Land Suitability Categories 4 and 5 where lowland hardwoods and brush species are managed for browse and cover. Approximately 42,500 acres of these soils within the subarea outside of the State areas provide wildlife habitat on privately owned lands.

The greatest amount of forested land in Subarea 2 is found in the northern half of the subarea--attributable to the fact that the southern half is highly urbanized (Pontiac and Mt. Clemens). The forest resource can be described as located in small farm woodlots with no large blocks (over 640 acres) present. Most of the individual blocks range from 1 to 320 acres. The majority of the larger blocks are located on poorly drained soils and are stocked predominantly with lowland hardwoods and offsite aspen. This subarea, outside of the present urban areas, has a high percentage of land suitable for forestry purposes. Of the 175,400 acres of Forest Land Suitability Categories 1 and 2, 31,000 acres are presently in forest cover.

Subarea 3 is the most highly urbanized subarea in the Study Area. Forested tracts that have not been developed serve residents by providing much-needed open space, greenbelts, recreational areas, wildlife habitat, ground water recharge areas, etc.

Approximately 42,800 acres of Forest Land Suitability Category 1 soils are in the undeveloped areas of this subarea.

Subarea 4 is generally rural in character now and projections indicate that it will remain this way in the future. A large block of Forest Land Suitability Category 2 soils exists in the northwest corner of the subarea.

Many diverse uses of forest land can be noted because of the proximity of this rural subarea to urban areas. Such uses include wildlife habitat, small privately owned campgrounds, hunting preserves, cabin developments, and trails for hiking, horseback riding, and bicycling.

The major land uses in Subarea 5 are urbanization and outdoor recreation.

Forest Land Suitability Category 4 and 5 soils are used quite extensively by migratory waterfowl and resident Canada goose flocks. The intermingled forested lands preserve the semi-natural appearance of these habitat areas. In addition, the lowland hardwoods and brush species on these soils provide cover and browse for all species of upland birds and game animals common to the area.

The forest resource is playing an increasingly important role in providing a high quality and aesthetically pleasing environment. This is evidenced by small acreages that are being afforested around isolated rural residences and parks. The gently rolling topography of the western portions of the subarea, coupled with the presence of soils suitable for forestry purposes, presents the landscape planner with an excellent opportunity for environmental enhancement.

The number of National Champion Trees found in a region reflects the potential the region has for growing trees. A National Champion Tree, as defined by the American Forestry Association, is the largest reported example of its species in the United States. There are 26 such trees in southeastern Michigan which qualify as National Champions according to information taken from American Forests Magazine, April 1973. A list of these trees is given in Appendix C.

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

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BLACK RIVER BASIN

LAPEER CO.

ST. CLAIR CO.

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MICHIGAN
UNITED STATES
CANADA
ONTARIO

JOINS LOWER LEFT

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BELLE RIVER BASIN

PINE RIVER BASIN

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HURON RIVER BASIN

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ADRIAN

RIVER RAISIN BASIN

MONROE

MONROE CO.

LAKE ERIE

FULTON CO.

MICHIGAN
OHIO

MICHIGAN
UNITED STATES
CANADA
ONTARIO

N

SCALE 1/615,150

SCALE I 0 1 2 3 4 5 6 7 8 9 MILES

LEGEND

- STATE LINE
- COUNTY LINE
- STREAM, LARGE
- STREAM, SMALL
- LAKE
- HIGHWAY, INTERSTATE
- HIGHWAY, U S
- HIGHWAY, STATE
- OTHER HIGHWAYS
- CITY BOUNDARY
- BASIN BOUNDARY
- STUDY AREA BOUNDARY
- SUBAREA BOUNDARY

CATEGORY

1 SUITABLE FOR COMMERCIAL TIMBER, SECONDARY RECREATION, AND WILDLIFE HABITAT.

2 SUITABLE FOR RECREATION, SECONDARY TIMBER PRODUCTION, AND WILDLIFE HABITAT

3 SUITABLE FOR ENVIRONMENTAL ENHANCEMENT AND GREEN BELTS, SECONDARY WILDLIFE HABITAT

4 SUITABLE FOR UPLAND WILDLIFE HABITAT, SECONDARY ESTHETICS, AND OPEN SPACE

5 SUITABLE FOR WETLAND WILDLIFE HABITAT SECONDARY ESTHETICS, AND ENVIRONMENTAL ENHANCEMENT

6 EXISTING URBAN AREAS

MICHIGAN
WISCONSIN
ILLINOIS
INDIANA
OHIO
LAKE MICHIGAN
LAKE HURON

SOUTHEASTERN MICHIGAN WATER RESOURCES STUDY

MICHIGAN

FOREST LAND SUITABILITY CATEGORIES

U.S. DEPARTMENT OF AGRICULTURE
Economic Research Service, Forest Service
and Soil Conservation Service

FIGURE 2-6

SOURCE
SCS DRAWING NUMBER 5,R-31,919-1 AND
INFORMATION FROM FIELD TECHNICIANS

POLYCONIC PROJECTION

3-14-73
5,R-32,432

USDA-SCS-LINCOLN NEBR. 1974

Photo by: Michigan Department of Natural Resources

THE FORESTED LANDSCAPE CAN OFTEN PROVIDE THE CASUAL VISITOR WITH A PLACE TO GET AWAY FROM THE PRESSURES OF EVERYDAY LIFE.

Wildlife

Although approximately 17 percent of the Study Area is in urban and built-up use and provides poor wildlife habitat, good habitat is

available in the cropland, forest land, and pastureland composing the remainder of the region. Numerous species of birds, waterfowl, and other small game are found throughout the area.

Cropland, pastureland, and forest land provide the major habitats for wildlife in the Study Area. Fifty-seven percent of the Study Area is in cropland, 3 percent in pastureland, and 16 percent in forest land. The majority of cropland is found in Lenawee, Monroe, Sanilac, and St. Clair Counties. Livingston, Washtenaw, and Oakland Counties contain the majority of forest land. Pastureland is scattered throughout the Study Area.

Some of the more productive wildlife habitats are the wetlands that are scattered throughout the Study Area. Forty-one townships in seven counties have wetlands whose total area is 10 percent or more of the township (Table 2-7).

TABLE 2-7--Major Inland Wetland Areas

County	Townships
Lapeer	NW Almont, N Burnside, SW Imlay
Lenawee	Cambridge, NW Franklin, Hudson, SW Madison
Livingston	S Unadilla, S Putnam, Hamburg, Green Oak
Macomb	S Bruce, N Washington
Oakland	SW Addison, Groveland, Highland, Holly, NW Oakland, NE Orion, SE Oxford, Rose, Springfield, S Waterford, White Lake
Sanilac	Buel, Minden, Washington, NE Watertown, Wheatland
Washtenaw	Augusta, Dexter, Freedom, Lima, Lodi, Lyndon, Manchester, Northfield, Scio, Sharon, Sylvan, N Webster

A variety of wildlife species can be found in the Study Area (Figure 2-7). Deer are plentiful in the rolling rural land of the moraine and outwash areas (Table 2-8). Muskrats and mink are relatively abundant in the flat lake plain areas as well as the rolling upland areas.

According to 1969 Michigan Department of Natural Resources records, the region yielded 40 percent of the State's cottontail rabbit harvest, 35 percent of the raccoons, 28 percent of the ducks, and 12 percent of the ring-necked pheasants.

TABLE 2-8--General Wildlife Abundance and Distribution

Species	Lake Plain Area	Moraine and Outwash Areas
Ring-necked Pheasant	1-80/sq.mile	1-80/sq.mile
Bobwhite Quail	1-30/sq.mile	1-30/sq.mile
Ruffed Grouse	20-30/sq.mile	5-10/sq.mile
Woodcock	10-20/sq.mile	5-10/sq.mile
Ducks (resident)	5-9 pairs/sq.mile	2-5 pairs/sq.mile
Geese (resident)	0-0.2 pairs/sq.mile	1-2 pairs/sq.mile
Cottontail Rabbit	20-30/100 acres	30-40/100 acres
Tree Squirrels	0-2/5 acres	2-4/5 acres
Deer	0-5/sq.mile	5-10/sq.mile
Muskrat	20-25/acre of habitat	20-25/acre of habitat
Mourning Dove	10-20/20 mile route	10-20/20 mile route

Red fox, woodchuck, Hungarian partridge, hawks, crows, and turkey vultures have been observed in the Study Area, but no census data is available. Of the furbearers, mink, weasel, beaver, skunk, opposum, and raccoon are found in the Study Area, but data is not available except for statewide trapping records.

According to the 1974 list entitled "Extirpated, Endangered, and Rare Fish and Wildlife in Michigan", published by the Department of Fisheries and Wildlife at Michigan State University, there are several rare and endangered species that could be in the Southeastern Michigan area. However, reasonable but unsuccessful efforts were made to determine if any were actually in the Study Area and State officials do not have any indication that the species have been seen or exist in the area.

Water Resources

Bedrock and glacial drift are both sources of ground water in southeastern Michigan. Wells in bedrock, with the exception of those in cavernous and fractured dolomite in Monroe and southern Wayne Counties, yield 100 gallons per minute or less. More characteristically the yields are 10 gallons per minute or less (Figure 2-8).

Wells in the cavernous and fractured dolomite area will yield 500 gallons per minute or more. The water, however, is too highly mineralized for domestic and public use, having 1,000 parts per million or more of dissolved solids. Also, the glacial drift in this area is thin and surface water pollution of these wells is common.

Water from wells in bedrock from the eastern part of the area outside of the cavernous dolomite area also have high dissolved solid content. Water from wells lying in the western part has a much lower dissolved solid content and is more tolerable for domestic and public use.

The rolling, glacial drift and outwash plains lying in the western part of the area have the most profuse yields of ground water. Here yields from wells located in the numerous sand and gravel layers are frequently 500 gallons per minute or more. Well yields of 100 gallons per minute or more are found extensively and yields of 10 gallons per minute or more are commonplace (Figure 2-9).

Glacial drift lying in the eastern parts of the area tend to have much more clay and less abundance of porous layers. Wells in this area generally yield 10 gallons per minute or less. High yield wells in the glacial drift of this area are rare.

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

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BLACK RIVER BASIN

LAPEER CO.

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ILLINOIS

WISCONSIN

MICHIGAN

LAKE MICHIGAN

LAKE HURON

MICHIGAN
UNITED STATES
CANADA
ONTARIO

N

LEGEND

- STATE LINE
- COUNTY LINE
- STREAM, LARGE
- STREAM, SMALL
- LAKE
- HIGHWAY, INTERSTATE
- HIGHWAY, U.S.
- HIGHWAY, STATE
- OTHER HIGHWAYS
- CITY BOUNDARY
- BASIN BOUNDARY
- STUDY AREA BOUNDARY

GOOD HABITAT AREAS FOR WATERFOWL, HERON, BITTERN, RAILS, WOODCOCK, OTHER AQUATIC BIRDS, RACCOON, MUSKRAT, AND MINK

GOOD HABITAT AREAS FOR PHEASANT, QUAIL, DOVE ROODENTS, HAWKS, SKUNK, AND FOX.

GOOD HABITAT AREAS FOR RESIDENT CANADA GOOSE POPULATION

GOOD HABITAT AREAS FOR DEER, FOX, SQUIRREL, AND COTTONTAIL RABBIT

SCALE 1/615,150

SCALE 1 0 1 2 3 4 5 6 7 8 9 MILES

POLYCONIC PROJECTION

SOURCE:
SCS DRAWING S.R- 31,919, SCS FIELD SURVEYS, 1970 ASCS AERIAL PHOTOS

FIGURE 2-7

SOUTHEASTERN MICHIGAN WATER RESOURCES STUDY

MICHIGAN

GENERAL WILDLIFE HABITAT

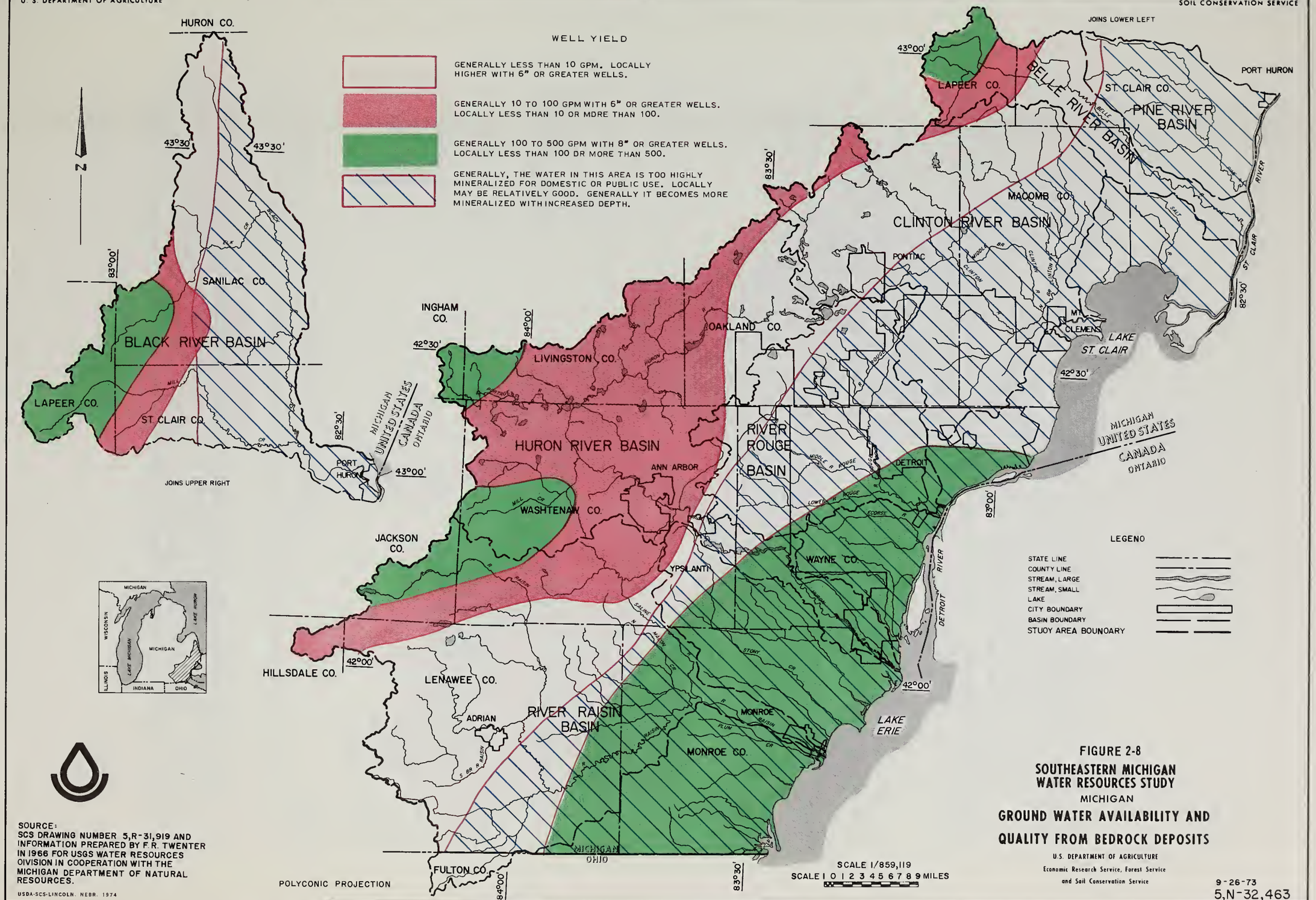
U.S. DEPARTMENT OF AGRICULTURE
Economic Research Service, Forest Service
and Soil Conservation Service

S.R- 32,264

USDA-SCS-LINCOLN, NEBR. 1974

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



SOURCE:
SCS DRAWING NUMBER 5,R-31,919 AND INFORMATION PREPARED BY F.R. TWENTER IN 1966 FOR USGS WATER RESOURCES DIVISION IN COOPERATION WITH THE MICHIGAN DEPARTMENT OF NATURAL RESOURCES.

USDA-SCS-LINCOLN, NEBR. 1974

POLYCONIC PROJECTION

SCALE 1/859,119

SCALE 1 0 1 2 3 4 5 6 7 8 9 MILES

FIGURE 2-8

SOUTHEASTERN MICHIGAN WATER RESOURCES STUDY

MICHIGAN

GROUND WATER AVAILABILITY AND QUALITY FROM BEDROCK DEPOSITS

U.S. DEPARTMENT OF AGRICULTURE
Economic Research Service, Forest Service and Soil Conservation Service

9-26-73
5,N-32,463

Quality of water from wells in glacial drift is generally good. However, the water tends to be hard, with an abundance of bicarbonates. Dissolved solids range from about 300 to 600 parts per million. Where the glacial drift is thin, the water quality is often poor. It may contain high saline and sulphide concentrations, which are derived from underlying bedrock. This is particularly true in the eastern part of southeastern Michigan.

There are 3,145 lakes and ponds in the Study Area, with about 49,600 acres of surface area, according to U.S. Geological Survey hydrologic data reports (Table 2-9). They range in size from the 1,270-acre Belleville Lake (a man-made lake) to less than an acre. The majority of the bodies of water are on morainal and outwash materials in the western part of the region. The lakes and ponds in the lake plain areas are small and widely scattered. In almost all cases the lakes are used for recreational purposes.

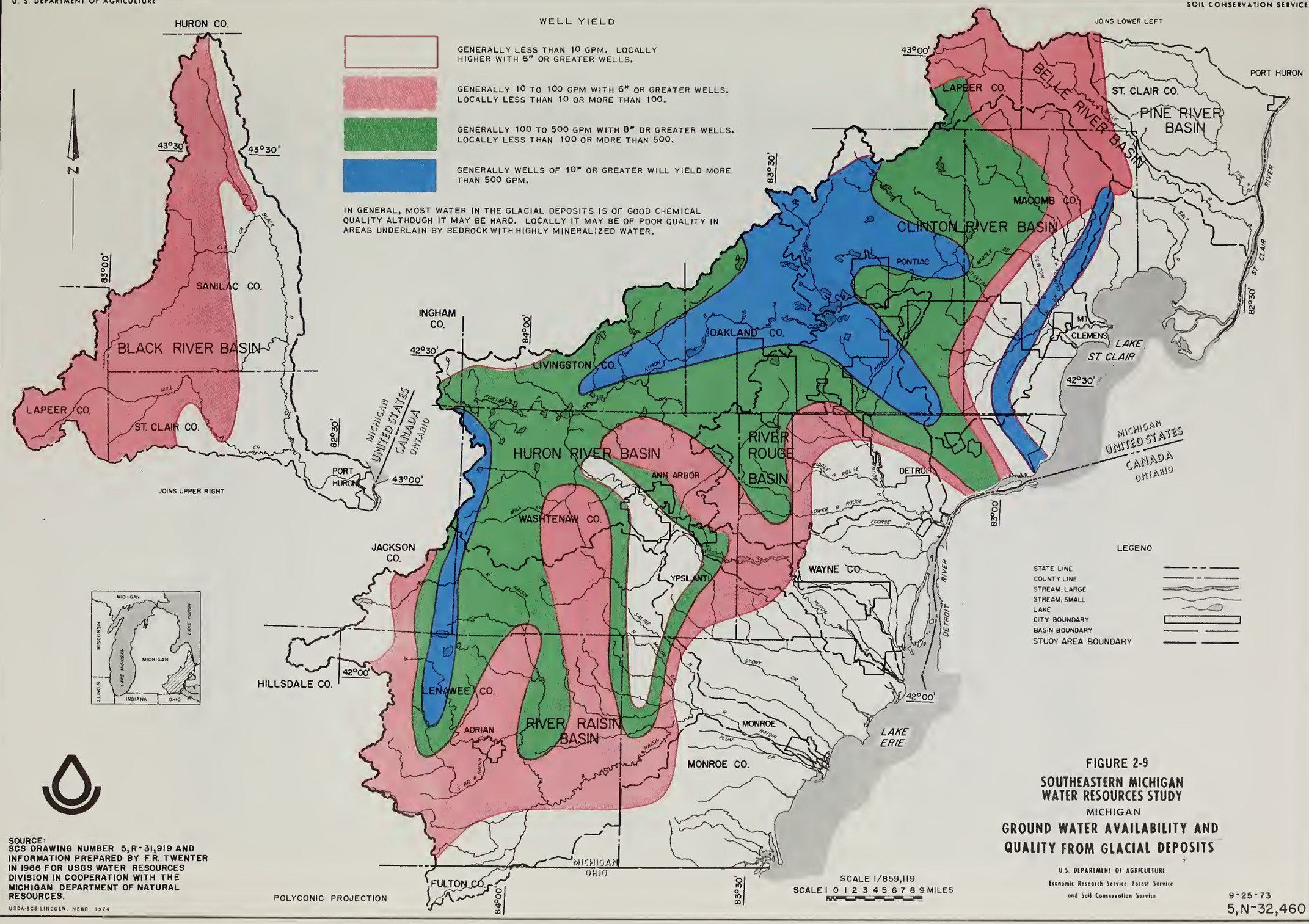
TABLE 2-9--Existing Lakes and Ponds

River Basin	Number of Lakes and Ponds	Total Surface Area (acres)
Black River	48	578
Belle River	61	170
Pine River	23	18
Clinton River	670	11,697
Huron River	1,058	24,613
River Rouge	404	2,674
River Raisin	429	7,222
minor rivers	452	2,635
TOTAL	3,145	49,607

The Great Lakes are the primary source of water in the Study Area. In 1970, 91.4 percent of the population served by municipal water supply used water withdrawn from the Great Lakes, 5.9 percent from ground water sources, and 2.7 percent from inland surface water. The water supply

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



SOURCE:
SCS DRAWING NUMBER 5,R-31,919 AND INFORMATION PREPARED BY F.R. TWENTER IN 1966 FOR USGS WATER RESOURCES DIVISION IN COOPERATION WITH THE MICHIGAN DEPARTMENT OF NATURAL RESOURCES.

USDA-SCS-LINCOLN, NEBR. 1974

FIGURE 2-9

SOUTHEASTERN MICHIGAN WATER RESOURCES STUDY

MICHIGAN

GROUND WATER AVAILABILITY AND QUALITY FROM GLACIAL DEPOSITS

U.S. DEPARTMENT OF AGRICULTURE
Economic Research Service, Forest Service
and Soil Conservation Service

9-25-73
5,N-32,460

of approximately 87 percent of the population in the Study Area was obtained through central distribution systems. The remainder, predominantly rural users in the west, obtained their supply from ground water.

In 1970 the average daily withdrawal for municipal, industrial, and rural uses was 2,135 million gallons per day (mgd). Less than 5 percent of this was for rural uses. However, rural use accounted for 23 percent of the total daily consumption (Table 2-10).

TABLE 2-10--Summary of Municipal, Industrial, and Rural Water Use

Use	Requirement	Consumption
	mgd	
Urban		
Municipal	739	61
Industrial	1,297	135
Subtotal--Urban	2,036	196
Rural		
Domestic	4.1	1.0
Livestock	5.4	4.9
Irrigation	50	45
Spray Water	0.1	0.1
Non-farm	39.4	6.0
Subtotal--Rural	99.0	57.0
TOTAL	2,135	253

With the large volumes of water available from the Great Lakes and the extensive distribution available, future problems with supply are not anticipated.

Approximately 23,000 acres of agricultural cropland are being irrigated at present. Nearly half of this acreage is in sod production, while potatoes and small vegetables make up essentially all of the rest. Surface water is used as a supply for about 65 percent of the 400 systems in the Study Area, while ground water is used for most of the remainder. In a few systems, Lake Erie is used as a source. Surface supplies are primarily from streams or dugout ponds since retention sites are scarce near intensively farmed areas. Approximately 13,000 acre-feet of water are used to irrigate crops. Average water application is estimated at 10 to 11 inches.

Crop irrigation is expected to increase steadily in southeastern Michigan, although not at a dramatic rate. Total acres irrigated are projected to increase to 28,500 by 1980 to 43,000 by 2020. Irrigation of vegetable acreage is expected to increase 60 percent by 1980 and 260 percent by 2020. Sod irrigation acres will increase 50 percent by 1980 and then show only a slight increase to 2020. In contrast, irrigation of potatoes will drop to one third by 1980 and remain steady to 2020.

Water needs will be 44,000 acre-feet by 1980 and 58,000 acre-feet by 2020. Adequate water supply appears to be available from ground water or the numerous surface streams. Some areas of Macomb and St. Clair Counties may not have on-site sources of either surface or ground water. These areas are relatively near the St. Clair River or Lake St. Clair and could obtain supply from lake sources.

No present or future water shortages were identified that would require project development for irrigation.

Fishery

The many natural lakes in the area provide fishing opportunities. Large-and smallmouth bass, northern pike, muskellunge, and walleye are common, although crappie, perch, blue-gill, rock bass, and other panfish are plentiful. A number of lakes support trout as well as warmwater fish. This type of fisheries management has been successful in the area.

The rivers and streams in the Study Area provide habitat primarily for warmwater species. According to the Michigan Department of Natural Resources, there are approximately 890 miles of top quality warmwater streams that contain good populations of warmwater game fish (Figure 2-10). These streams have a relatively stable flow of good quality water, comparatively free of silt and other pollutants.

There are also about 2,500 miles of second quality warmwater streams. These streams are capable of supporting good populations of warmwater game fish except for such factors as lack of natural reproduction, overabundance of competing species, and presence of heavy silt load or other pollution.

In addition to the warmwater streams, some 60 miles of second quality coldwater streams are capable of supporting a trout fishery if certain fish management and pollution problems are corrected. The quality of the existing trout population is limited by such factors as lack of natural reproduction, overabundant competing species, and pollution.

Recreation

The report "Assessment of Outdoor Recreation Data," prepared for the Southeastern Michigan Water Resources Study by the U.S. Department of the Interior, Bureau of Outdoor Recreation, states that 173,890 acres of recreation land exist in the 10-county area (Table 2-11). Approximately 30 percent (52,600 acres) is private land operated and maintained by individuals who open their facilities to the public to make a profit. The remainder of the recreation land is in State, county, and local parks.

Urban development and competing land uses seriously limit the potential of the area for recreational development. There is, however, a potential recreational resource in the 114 feasible reservoir sites located in the upland areas of the basin (Figure 2-11). Topography and soil conditions are important considerations in determining a site potential. Since the lake plain area is relatively flat, most of the sites are in the western and northern parts, where terminal and ground moraine landforms are predominant. If fully developed, this resource would create about 12,010 acres of surface area, which could be used for recreational development (Table 2-12). This 173,420 acre-feet of water storage could also be used for flood protection, water supply, irrigation, or water quality control.

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

HURON CO.

SANILAC CO.

BLACK RIVER BASIN

LAPEER CO.

ST. CLAIR CO.

PORT HURON

JOINS UPPER RIGHT

MICHIGAN
UNITED STATES
CANADA
ONTARIO

JOINS LOWER LEFT

LAPEER CO.

BELLE RIVER BASIN

ST. CLAIR CO.

PINE RIVER BASIN

PORT HURON

MACOMB CO.

CLINTON RIVER BASIN

PONTIAC

INGHAM CO.

OAKLAND CO.

LIVINGSTON CO.

MT. CLEMENS

LAKE ST. CLAIR

HURON RIVER BASIN

RIVER ROUGE BASIN

ANN ARBOR

DETROIT

WASHTENAW CO.

JACKSON CO.

YPSILANTI

WAYNE CO.

DETROIT RIVER

HILLSDALE CO.

LENAWEE CO.

ADRIAN

RIVER RAISIN BASIN

MONROE

LAKE ERIE

MONROE CO.

MICHIGAN
OHIO

FULTON CO.

N

LEGEND

- STATE LINE
- COUNTY LINE
- STREAM, LARGE
- STREAM, SMALL
- LAKE
- HIGHWAY, INTERSTATE
- HIGHWAY, U S
- HIGHWAY, STATE
- OTHER HIGHWAYS
- CITY BOUNDARY
- BASIN BOUNDARY
- STUDY AREA BOUNDARY
- SECOND QUALITY TROUT STREAM
- TOP QUALITY WARM WATER STREAM
- SECOND QUALITY WARM WATER STREAM

SCALE 1/615,150

SCALE 1 0 1 2 3 4 5 6 7 8 9 MILES

FIGURE 2-10

SOUTHEASTERN MICHIGAN WATER RESOURCES STUDY

MICHIGAN

STREAM FISHERIES HABITAT

U.S. DEPARTMENT OF AGRICULTURE
Economic Research Service, Forest Service
and Soil Conservation Service

SOURCE:
SCS DRAWING NUMBER S.R.-M.919 AND MICHIGAN DEPARTMENT OF NATURAL RESOURCES STREAM CLASSIFICATION MAP

POLYCONIC PROJECTION

S.R.- 32,957

USDA-SCS-LINCOLN, NEBR. 1974

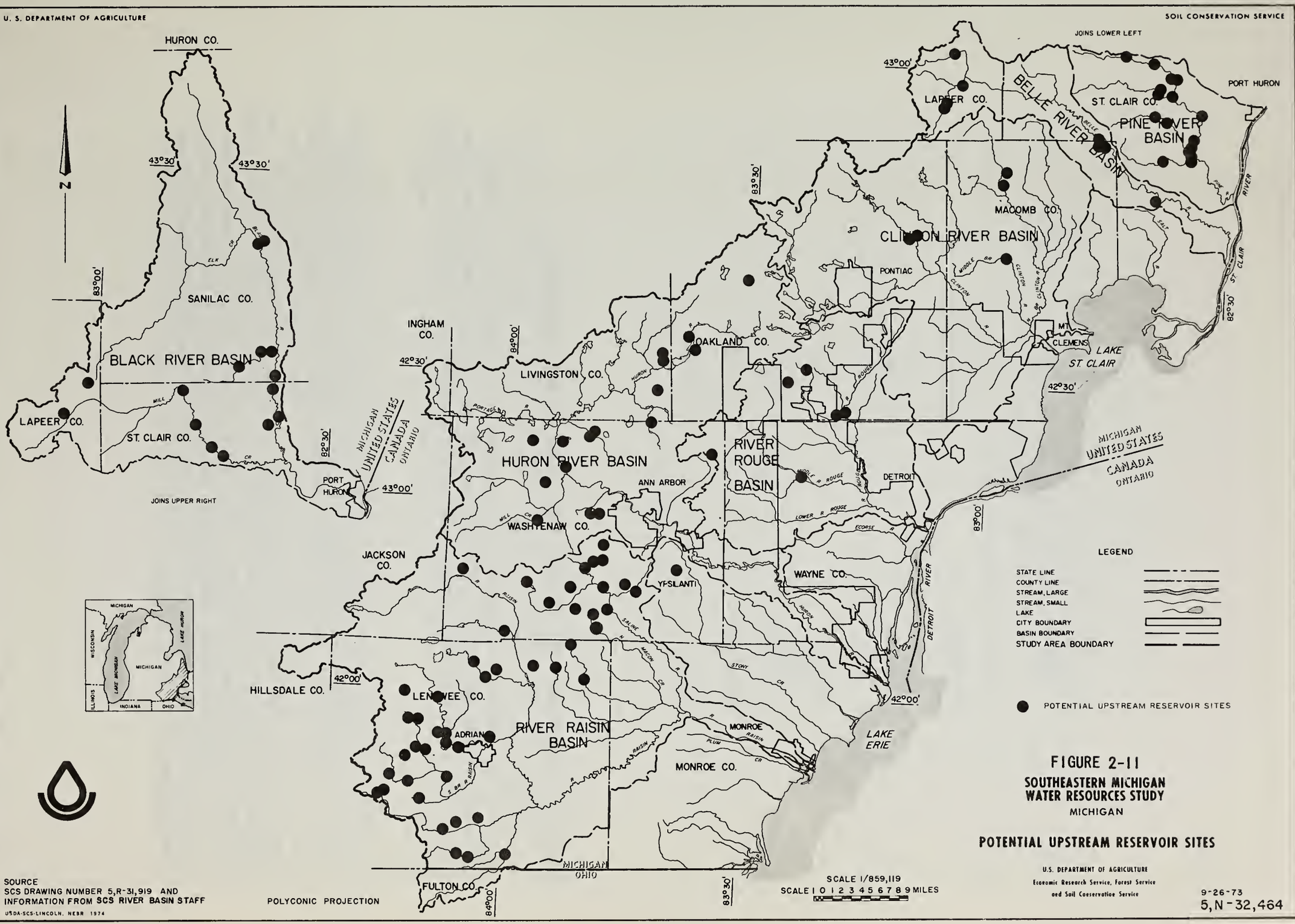


FIGURE 2-11

SOUTHEASTERN MICHIGAN WATER RESOURCES STUDY

MICHIGAN

POTENTIAL UPSTREAM RESERVOIR SITES

U.S. DEPARTMENT OF AGRICULTURE
Economic Research Service, Forest Service
and Soil Conservation Service

9-26-73
5,N-32,464

TABLE 2-11--Recreation Land in the 10-County Area

Ownership	Supply Acres
City	
Public	29,600
Private	14,590
Local	
Public	5,990
Private	38,010
Regional	85,700
TOTAL	173,890

Archeological and Historical Description

Initial human occupation of southeastern Michigan was by small bands of hunter-gatherers who moved north as glaciers retreated from the Valders maximum of the Wisconsin Glacial Stage. Lanceolate fluted projectile points used by these people have been found in 21 southern Michigan counties.

Man in the Archaic period (9000 to 1000 B.C.) is characterized as becoming proficient in adaptation to forest habitats. A thinly dispersed, band-level kind of culture became efficient in extracating food resources from a wide variety of habitat. Many Archaic societies became larger and more densely populated. During the later parts of the Archaic period, resources and artifacts, including copper from the upper peninsula of Michigan, became widely exchanged through regional trade routes. The increasing interaction among communities resulted in more stability of settlements and increasing status differentiation within communities.

TABLE 2-12--Potential Reservoir Sites

River Basin	Potential Reservoirs (No.)	Drainage Area (Acres)	Storage Capacity				Surface Area (Acres)
			Sediment	Other	Flood-Water	Total	
			Acre Feet				
Black	15	96	1,890	6,490	8,610	16,990	1,010
Pine	16	123	1,370	6,590	2,560	10,520	870
Belle	8	42	1,440	3,500	3,070	8,010	600
Clinton	5	98	1,238	2,750	340	4,330	650
Rouge	6	54	780	3,530	3,710	8,020	490
Huron	16	124	3,620	8,860	13,280	25,760	1,450
Raisin	48	501	14,420	44,170	41,200	99,790	6,940
TOTAL	114	1,038	24,758	75,890	72,770	173,420	12,010

The Woodland period (1000 B.C. to 1600 A.D.) has been defined primarily on the basis of the introduction of agriculture and ceramics to a basically archaic way of life. Throughout much of the Woodland period, hunting, fishing, and collecting plant food remained the primary sources of subsistence. By Middle and Late Woodland times, however, dense settlements of sedentary farming people existed in southeastern Michigan. Corn became an important trade item.

During the Middle Woodland period, which is contemporary with the Hopewell culture of Illinois and Ohio, interaction between these peoples increased rapidly. Hopewell-style ceramics were imported into southeastern Michigan and trade in other items became extensive.

In Michigan, the Late Woodland period (400 to 1600 A.D.) marked the peak in the efficiency of prehistoric adaptation, both in population density, and in social complexity. However, sometime between 1200 and 1600 A.D. the prehistoric population began to decline in southeastern Michigan and in all of the lower peninsula of Michigan. By 1600 there were signs of widespread depopulation of the region.

Most of the archeological sites in southeastern Michigan are remnants of the prolific aboriginal life of the Late Woodland period. Trade route trails were established and settlement patterns developed, which, in many cases, persist into modern times. The livelihood of the Late Woodland Indians, just as that of modern man, depended upon productive land, communication and trade, and settlement at strategic locations.

Hinsdale's "Archeological Atlas of Michigan," published in 1931, lists 292 locations of Indian villages, burial grounds, mounds, and various enclosures in the counties of southeastern Michigan (Table 2-13).

TABLE 2-13--Location of Archeological Sites

County	Villages	Burial Grounds	Mounds	Enclosures	TOTAL
Sanilac	1	3	22	4	30
St. Clair	7	10	24	-	41
Lapeer	15	6	15	-	41
Macomb	8	4	26	9	47
Oakland	15	8	5	-	28
Livingston	17	3	3	1	24
Washtenaw	8	2	5	-	15
Wayne	10	-	9	2	21
Lenawee	23	4	3	-	30
Monroe	9	6	-	-	15
TOTAL					292

Hinsdale's atlas, although the best statewide inventory data available for Michigan, is very much out of date. Recent surveys of counties show many more archeological sites than are indicated in Hinsdale's atlas. For example, in an article entitled "Preliminary Archeological Survey of Monroe County, Michigan" published in the March-June 1973 issue of The Michigan Archeologist, a recent survey by Brose and Essenpreis shows the following information for Monroe County:

1.	Villages	15
2.	Hunting camps and stations	70
3.	Permanent camps	15
4.	Small family camps	16
5.	Female camps	16
		132

The data shown in this survey of Monroe County would indicate the presence of perhaps as many as 10 times the number of identifiable archeological sites as listed by Hinsdale. Overall, there are probably several thousand sites of various types in the southeastern Michigan counties.

Southeastern Michigan's modern history dates back to the 1650's, when fur trappers began to travel in the region. A brief historical sketch of the area is found in Chapter 3 of this report. Results of this growth which followed are seen in the more than 60 historical sites listed in the National Register of Historic Places (Appendix D). These sites range from individual houses to entire districts of buildings and from tunnels to canals.

CHAPTER III

Economic Development

CHAPTER III

ECONOMIC DEVELOPMENT

HISTORICAL DEVELOPMENT

The original inhabitants of southeastern Michigan were American Indians. In the middle of the 17th century, French fur trappers began to roam the region, and a fur trading post was established on the site of Detroit in 1701. In the early 19th century, immigrants from Europe and eastern Americans moved into the region. In places such as the present Monroe and Wayne Counties, the density of heavy timber was a serious obstacle to settlers. Adjacent to these areas, however, there was a variety of oak openings, burr-oak plains, and small prairies. The prairies offered a special inducement to settlers from the States further south, who were familiar with prairie land.

It was not until the 1850's that the region saw a major and sustained growth in its population. Since the forests of the eastern States were almost gone, lumbermen by the thousands rushed into Michigan. Michigan lumber was needed to help build the towns and cities of the Midwest. By the early 1900's, most of the virgin forests had been cut. Agriculture became established on the cleared lands made accessible by logging roads. While timber resources were used in other sectors of the economy, farming replaced forestry as the major revenue-producer.

The abundance of the timber resource and proximity to waterway transportation made the State a good location for horse-carriage plants in the middle 1800's. By the turn of the century, these plants began to manufacture automobiles. Henry Ford, Ransom E. Olds, and other pioneer car makers helped make Detroit the automobile capital of the world. In 150 years southeastern Michigan has changed from a forest and grass-covered land to a major industrial and residential center.

AGRICULTURAL ECONOMIC ACTIVITY

Land in farms has been steadily declining in the Study Area, primarily due to urban expansion. Between 1954 and 1964, land in farms decreased 15 percent; between 1964 and 1969, an additional 9 percent drop reduced farm land to 2,097,700 acres (Table 3-1).

TABLE 3-1--Selected Characteristics of the Agricultural Economy, 1954-1969

Characteristic	Unit	1954	1959	1964	1969
Farms	No.	25,148	20,761	17,472	14,262
Average size	Ac.	107	120	133	142
Average value land/bldgs.	$/farm	21,400	34,700	44,400	69,900
Farmland	1,000 Ac.	2,717	2,506	2,320	2,098
Rural farm population	1,000 persons	157.7	130.9	78.4	76.9
Crops sold	$1,000	53,800	59,100	68,500	66,600

Sources: U.S. Census of Agriculture and of Population

Similarly, the number of farms and farm operators declined during the postwar period. Only 14,262 farms, with an average size of 142 acres, contributed to the overall economy of the region in 1969. This compares to 25,148 farms in 1954. The drop in number of farms paraleled the decline in rural farm population. Rural farm population decreased nearly 50 percent between 1950 and 1960. The rate of decline has lessened since 1960, however, and in 1970, 76,923 persons lived on farms, only a 2-percent drop from the 1960 level.

At the same time, average farm size has been increasing, from 107 acres in 1954 to 142 acres in 1969. In 1964, full owners comprised 64 percent of total farm operators, part owners 27 percent, but tenants only 9 percent. Most operators (62 percent) were full owners of their farms in 1969; 25 percent were part owners; and only 13 percent were tenants or managers.

Between 1954 and 1969, the average value of land and buildings per farm more than tripled from $21,400 to $69,900. Investments in livestock, machinery, and fertilizers, plus processing of food and kindred products, contributed to the region's economy. Between 1954 and 1964, the value of crop sales increased from $54 million to $68 million, dairy products rose from $30 million to $44 million, and livestock and livestock products increased from $60 million to $82 million. Between 1964 and 1969, total crop sales fell some 2 percent to $67 million.

The Census of Agriculture classifies commercial farms according to the major enterprises found on the farm. The major types in the Study Area are cash grain, dairy, and livestock other than dairy and poultry. Table 3-2 indicates that the numbers of each category have declined over the 15-year period.

TABLE 3-2--Commercial Farms by Type, 1954-1969

Type of Farm	1954	1959	1964	1969
	Number of Farms			
Grain	4,405	2,817	2,947	2,405
Dairy	4,997	3,862	3,112	1,893
Livestock (not dairy or poultry)	1,787	1,557	1,302	1,391
General	1,829	812	743	402
Other (vegetable, fruit and nuts, other field crops, poultry)	1,455	854	795	605

Source: U.S. Census of Agriculture

FOREST RELATED ECONOMIC ACTIVITY

The amount of timber products harvested from woodlands in the Study Area remained fairly steady from 1954 to 1965. However, the recent past evidenced a considerable decrease in timber harvest. The quantity of firewood cut today is small, but suburban and city dwellers use it for fireplace logs. In 1965, only 800 cord of pulpwood were cut in the region. The pulpwood market will become even less significant in the future since the only local paper mill at Detroit (Scott Paper Company) is no longer receiving roundwood and is presently importing pulp for the manufacture of paper. Sawlogs remain the major forest product. In 1965, 31,215 thousand board-feet (MBF) of sawlogs were harvested in the region. This volume, along with some logs trucked in from adjacent counties, was used by 25 sawmills located within the region to produce 38,450 MBF of lumber. The stumpage value of sawlogs cut in 1965 exceeded $1 million. Elm, red oak, and soft maple were the major tree species cut, accounting for 30 percent, 19 percent, and 16 percent of the volume, respectively.

Tables 3-3 and 3-4 show the relationship between timber product output and volume.

TABLE 3-3--Timber Products Output

Subarea	Sawlogs		Pulpwood	
	1965[1]	1970[2]	1965[1]	1970[2]
1	18,500	10,000	800	0
2	1,350	300	0	0
3	Data not available		0	0
4	3,800	3,250	0	0
5	14,800	250	0	0
TOTAL	38,450	13,800	800	0

[1]Michigan Sawlog and Lumber Production, 1965, Michigan Cons.
[2]Directory of Primary Wood Using Plants in Michigan, Michigan Department of Natural Resources, 1970.

TABLE 3-4--Distribution of Forest Volume

Subarea	Commercial Forest Land	
	Growing Stock	Sawtimber
	Million Cubic Feet	Million Board Feet
1	92.5	239.6
2	118.8	338.1
3	26.2	79.1
4	64.4	190.7
5	115.9	349.5
TOTAL	417.8	1197.8

The number of sawmills remained relatively stable from 1954 to 1965, while pulp, paper, and paper board mills dropped from 13 to 1. However, from 1965 to 1970, the number of sawmills dropped from 25 to 12. Current information on the number of employees and the annual payrolls for wood-using plants is not available, but based on the marked decrease in the number of mills, the payroll is significantly reduced from the estimated 9,800 employees and $62 million given in 1963 (this figure includes primary and secondary manufacturing facilities and logging contractors and pulp and paper mills).

Because of the great variation in forest-related economic activity throughout the Study Area, it is desirable to analyze this activity by subarea.

SUBAREA 1

Commercial timber production is a significant use and projections indicate that the subarea will remain rural in character and that timber production will continue to be a viable economic activity. In 1970, 10 million board feet (MMBF) were milled in the subarea and an estimated 5 to 6 MMBF were cut in the subarea and trucked to mills outside of the subarea. Landowner requests for technical forestry assistance are increasing, which is an indication of the concern that owners have for the value of their woodlots. Several large Christmas tree farms operate in the area; however, high land values and labor costs will preclude the establishment of this business in the future.

SUBAREAS 2 AND 3

Commercial timber production within these subareas was negligible in 1970. Only 300 thousand board feet (MBF) were milled in the subareas and a small amount was trucked to mills outside of the subareas. With the urban expansion that is projected, timber production will be virtually nonexistent by 1980.

SUBAREA 4

Thirteen percent, or 133,000 acres, of the subarea is forested. As could be expected because of the rural nature of the subarea, commercial timber production assumes a more important role here than in the predominantly urban subareas. Approximately 3,250 MBF were milled in this subbasin in 1970. The opportunity exists for the promotion of certain high value species (black walnut and cherry) on the better sites.

SUBAREA 5

Commercial timber production has declined rapidly in the subarea to the point where "in subarea" harvest and milling is almost nonexistent. An estimated 250 MBF were milled in the subarea in 1970 and a smaller quantity was trucked from the subarea to outside mills. Based on urban and recreation projections, commercial timber production will be a relatively insignificant land use.

PROJECTED AGRICULTURAL AND RELATED ECONOMIC ACTIVITY

Data on present land use, yields, and production was developed from the Great Lakes Basin Framework Study and the 1967 Conservation Needs Inventory to form a "current normal" level of data. This "current normal" is needed to standardize projected yields, to adjust cropping patterns, and to form a basis for comparison with the 1980 and 2020 projections.

A HARVEST CUT TWO YEARS PREVIOUS TO THE PHOTOGRAPH DID NOT IMPAIR THE AESTHETICS OF THE AREA.

Generalized current and projected yield indices for the major field and specialty crops are displayed in Tables 3-5 and 3-6. While specific crop yields were projected individually by soil group, these generalized indices can be useful indicators in approximating future production levels. Generalized 2020 indices for all of the major crops are expected to be 60 to 80 percent above the current normal. Specialty crop indices show more variation but are expected to be 90 to 170 percent greater.

TABLE 3-5--Generalized Yield Indices for Major Field Crops

Crop	Unit	Current Normal[1]	Yield Indices[2]			
			Current Normal	1980	2000	2020
Corn	Bu.	73	100	125	148	168
Corn silage	Tons	12	100	133	158	180
Soybeans	Bu.	26	100	119	150	177
Wheat	Bu.	39	100	128	154	179
Oats	Bu.	63	100	119	140	159
Alfalfa hay	Tons	2.4	100	125	154	175
Clover-timothy and other hay	Tons	1.7	100	135	159	182

[1] 1967

[2] Generalized yield indices represent the general magnitude of yield increase. They are generalized for all soils in the Study Area, and, hence are not appropriate for analyzing future production levels of specific crops.

TABLE 3-6--Generalized Yield Indices
for Specialty Crops

Crop	Unit	Current Normal[1]	Yield Indices[2] Current Normal	1980	2000	2020
Potatoes	Cwt.	150	100	186	233	266
Dry field beans	Cwt.	10	100	145	172	195
Sugar beets	Cwt.	15	100	147	180	207
Non-citrus fruits	Tons	3	100	146	206	263
Commercial vegetables	Cwt.	106	100	127	165	193

[1] 1967

[2] Generalized yield indices represent the general magnitude of yield increase. They are generalized for all soils in the Study Area, and, hence are not appropriate for analyzing future production levels of specific crops.

Future agricultural requirements for the Study Area are derived from projected national requirements. These national requirements for food, feed, and fiber were prepared by using OBERS Series C population projections. (OBERS refers to an unified effort of the Office of Business Economics, U.S. Department of Commerce, and the Economic Research Service, U.S. Department of Agriculture.) The size of the requirements was determined through consideration of trends in population, per capita income, consumer tastes, industrial uses, livestock feeding efficiencies, imports, and exports. In the appraisal of future conditions it was necessary to rely heavily on historical trends and relationships.

The Study Area's share of national production requirements was determined by a national interregional analysis of historical shares and trends. Regional production shares were allocated to Planning Subarea 4.1 in the Great Lakes Basin Framework Study. In the calculation of these production shares it is assumed that there will be no additional development of water and related land resources. Planning Subarea 4.1 coincides with the Southeastern Michigan Study Area on county boundaries, so the requirements of this planning subarea were adjusted for the hydrologic boundaries of the Study Area and its subareas.

Livestock projections are a partial determinant of field crop projections, particularly roughages. Hence, it was necessary to project feed conversion rates and the feed grain-roughage composition of the livestock ration to determine total feed grain requirements.

Tables 3-7 through 3-13 summarize the region's crop acreage and production requirements for 1980 and 2020. This set of projections indicates that the region's productive capacity is adequate to meet future production requirements.[1] This conclusion is directly dependent on assumptions underlying the projections.

The estimates of the region's future productive capacity are heavily dependent on yield estimates and the availability of idle cropland for agricultural production. It is very difficult to predict future yield levels. For example, future increases could be affected by social attitudes toward the use of herbicides and insecticides. Therefore, the actual amount of land in excess of that needed to meet production needs is directly proportional to any difference between actual future yields and those assumed. The Series C projections indicate that excess or idle cropland is expected to be some 640,000 acres in 1980, or 35 percent of total cropland acreage. By 2020, only 20,000 acres, or less than 2 percent of total cropland acreage, would be idle. This conclusion is based on the crucial assumption that as food, feed, and fiber requirements increase from 1980 to 2020, all land considered idle will be fully available for agricultural production.

The projections indicate a substantial increase in production between 1967 and 2020 for each of the major crops except oats, which are expected to decrease 27 percent (Table 3-13). The greatest production increases are projected for dry beans (259 percent), soybeans (142 percent), and wheat (126 percent). Because of projected yield increases, acreage changes for all crops are less dramatic. Of the seven crops, four are expected to contract 20 to 50 percent. Acreage for dry beans is expected to expand some 85 percent; acreages for wheat and for soybeans are also expected to expand somewhat.

[1] A revised set of future production requirements have recently been developed by OBERS using Series E projections. These projections were not available for this study.

TABLE 3-7--Current and Projected Crop Acreage and Production in the Study Area, 1980 and 2020

Crop	Unit	Current Normal[1]		1980		2020	
		Acres	Production	Acres	Production	Acres	Production
Wheat	Bu.	160.3	5,813	197.2	8,684	221.9	13,147
Oats	Bu.	73.6	4,278	74.5	5,439	39.6	3,133
Other small grain	Bu.	2.5	168	5.3	232	5.3	281
Corn grain	Bu.	312.4	21,464	198.4	20,770	243.7	32,406
Corn silage	Tons	78.8	854	54.0	953	51.2	1,117
Soybeans	Bu.	263.9	6,691	301.9	10,355	307.3	16,136
Dry edible beans	Cwt.	43.1	430	51.2	745	81.6	1,544
Sugar beets	Tons	18.3	273	20.1	302	29.1	931
Potatoes	Cwt.	15.7	2,025	2.7	754	3.4	1,145
Fruit	Tons	13.5	40	4.7	417	5.6	38
Commercial veg.	Cwt.	39.8	4,229	33.3	4,542	30.5	6,260
Alfalfa hay	Tons	159.5	346	151.9	42	141.9	518
Clover-timothy hay	Tons	50.9	66	43.2	85	15.5	40
Cropland and pasture	Tons Equiv.	9.0	15	7.3	17	7.9	23
Sod	Acres	15.4	15	15.7	16	16.4	16
Idle Cropland	Acres	161.7		639.1		20.5	
Total Cropland	Acres	1,918.4		1,800.5		1,227.4	
Improved Pasture	Tons Equiv.	20.7	29	36.8	73	20.5	56
Improvable pasture	Tons Equiv.	72.5	41	47.9	38	37.7	44
Total Pasture	Tons Equiv.	93.2	70	84.7	111	58.2	100
Total crop and pasture land	Acres	2,011.6		1,885.2		1,285.6	

[1] 1967.

TABLE 3-8--Current and Projected Crop Acreage and Production in Subarea 1, 1980 and 2020

Crop	Unit	Current Normal[1]		1980		2020	
		Acres	Production	Acres	Production	Acres	Production
		1,000 Units					
Wheat	Bu.	48.3	1,625	55.0	2,476	76.2	4,414
Oats	Bu.	37.2	2,041	43.6	3,893	32.8	2,530
Other small grain	Bu.	.9	54	2.6	139	3.0	167
Corn grain	Bu.	64.0	4,258	54.2	5,799	127.4	17,080
Corn silage	Tons	26.0	277	19.6	357	33.2	692
Soybeans	Bu.	6.5	151	7.0	244	15.7	629
Dry edible beans	Cwt.	41.4	414	49.9	720	79.5	1,551
Sugar beets	Tons	11.8	177	7.1	105	8.7	277
Potatoes	Cwt.	.2	30	.1	23	--	--
Fruit	Tons	2.9	9	.8		1.2	8
Commercial veg.	Cwt.	6.4	678	11.8	1,584	12.6	2,567
Alfalfa hay	Tons	76.7	162	88.3	247	107.1	371
Clover-timothy hay	Tons	36.4	46	33.7	64	11.6	30
Cropland pasture	Tons Equiv.	1.9	3	1.2	3	1.8	5
Sod	Acres	3.5	4	3.6	4	3.8	4
Idle cropland	Acres	242.7		213.8		5.7	
Total Cropland	Acres	606.8		592.3		520.3	
Improved pasture	Tons Equiv.	9.9	12	10.9	22	2.2	7
Improvable pasture	Tons Equiv.	21.3	12	18.4	15	22.3	28
Total pasture	Tons Equiv.	31.2	24	29.3	37	24.5	34
Total crop and pasture land	Acres	638.0		621.6		544.8	

[1] 1967.

TABLE 3-9--Current and Projected Crop Acreage and Production in Subarea 2, 1980 and 2020

Crop	Unit	Current Normal[1]		1980		2020	
		Acres	Production	Acres	Production	Acres	Production
		1,000 Units					
Wheat	Bu.	8.0	318	9.0	492	21.0	1,255
Oats	Bu.	2.8	175	3.3	270	.8	83
Other small grain	Bu.	.9	54	1.1	58	.8	45
Corn grain	Bu.	21.5	1,363	19.3	2,110	36.7	5,554
Corn silage	Tons	11.3	112	9.6	173	11.2	210
Soybeans	Bu.	6.6	155	7.1	255	17.7	674
Dry edible beans	Cwt.	1.7	17	1.3	19	2.1	42
Sugar beets	Tons	.1	2	.6	9	.9	27
Potatoes	Cwt.	1.6	240	.6	156	.5	164
Fruit	Tons	3.7	11	1.7	6	2.1	14
Commercial veg.	Cwt.	5.7	604	5.9	802	2.8	563
Alfalfa hay	Tons	16.6	37	17.1	58	7.8	35
Clover-timothy hay	Tons	2.9	4	2.7	6	.5	2
Cropland pasture	Tons Equiv.	3.5	6	3.4	8	2.4	6
Sod	Acres	3.9	4	4.0	4	4.4	4
Idle cropland	Acres	134.1		107.4		1.2	
Total cropland	Acres	224.9		194.5		112.9	
Improved pasture	Tons Equiv.	3.5	6	4.7	10	3.2	10
Improvable pasture	Tons Equiv.	6.1	5	3.5	3	1.5	2
Total Pasture	Tons Equiv.	9.6	11	8.2	13	4.7	12
Total crop and pasture land	Acres	234.5		202.7		117.6	

[1] 1967.

TABLE 3-10--Current and Projected Crop Acreage and Production in Subarea 3, 1980 and 2020

Crop	Unit	Current Normal[1]		1980		2020	
		Acres	Production	Acres	Production	Acres	Production
		1,000 Units					
Wheat	Bu.	1.6	51	1.8	76	---	---
Oats	Bu.	---	---	---	---	---	---
Other small grain	Bu.	---	---	---	---	---	---
Corn grain	Bu.	11.7	717	5.2	574	---	---
Corn silage	Tons	---	---	---	---	---	---
Soybeans	Bu.	1.6	39	1.9	63	---	---
Dry edible beans	Cwt.	---	---	---	---	---	---
Sugar beets	Tons	---	---	---	---	---	---
Potatoes	Cwt.	2.2	13	---	---	---	---
Fruit	Tons	3.4	10	.5	2	.2	1
Commercial veg.	Cwt.	12.6	1,336	2.7	348	.3	63
Alfalfa hay	Tons	1.9	3	1.1	3	---	---
Clover-timothy hay	Tons	.4	1	.5	1	---	---
Cropland pasture	Tons Equiv.	---	---	---	---	---	---
Sod	Acres	1.5	2	1.5	2	1.5	2
Idle cropland	Acres	26.5	---	9.9	---	---	---
Total cropland	Acres	63.4	---	25.1	---	2.0	---
Improved pasture	Tons Equiv.	---	---	---	---	---	---
Improvable pasture	Tons Equiv.	.9	1	.6	---	0.1	1
Total pasture	Tons Equiv.	.9	1	.7	1	0.1	2
Total crop and pasture land	Acres	64.3		25.7		2.1	

[1] 1967.

TABLE 3-11--Current and Projected Crop Acreage and Production in Subarea 4, 1980 and 2020

Crop	Unit	Current Normal[1]		1980		2020	
		Acres	Production	Acres	Production	Acres	Production
		1,000 Units					
Wheat	Bu.	78.9	2,939	99.4	4,326	71.6	4,369
Oats	Bu.	24.7	1,517	16.3	1,219	3.4	333
Other small grain	Bu.	---	---	---	---	---	---
Corn grain	Bu.	175.6	12,416	96.8	10,005	64.4	8,482
Corn silage	Tons	28.6	322	16.5	292	8.8	165
Soybeans	Bu.	233.5	5,951	264.6	9,079	245.1	13,053
Dry Edible Beans	Cwt.	---	---	---	---	---	---
Sugar beets	Tons	6.4	96	12.4	184	19.5	605
Potatoes	Cwt.	11.0	1,650	1.7	488	2.4	792
Fruit	Tons	1.9	6	1.1	4	1.8	12
Commercial veg.	Cwt.	13.8	1,462	10.4	1,405	11.	2,280
Alfalfa hay	Tons	29.1	60	18.7	58	15.6	71
Clover-timothy hay	Tons	3.7	6	2.1	---	1.1	3
Cropland pasture	Tons Equiv.	1.6	3	1.3	3	1.8	6
Sod	Acres	3.4	3	3.4	3	3.4	3
Idle cropland	Acres	138.4	---	184.0	---	9.3	---
Total cropland	Acres	750.6	---	728.7	---	459.4	---
Improved pasture	Tons Equiv.	.7	---	9.1	18	5.4	15
Improvable pasture	Tons Equiv.	22.6	---	12.8	10	9.8	11
Total pasture	Tons Equiv.	23.3	---	21.9	28	15.2	26
Total crop and pasture land	Acres	773.9		750.6		474.6	

[1] 1967.

TABLE 3-12--Current and Projected Crop Acreage and Production in Subarea 5, 1980 and 2020

Crop	Unit	Current Normal[1]		1980		2020	
		Acres	Production	Acres	Production	Acres	Production
		1,000 Units					
Wheat	Bu.	23.5	880	32.0	1,308	53.1	3,160
Oats	Bu.	8.9	546	11.3	848	2.6	245
Other small grain	Bu.	.7	18.7	1.6	85	1.5	86
Corn grain	Bu.	39.6	2,710	22.9	2,257	15.2	1,751
Corn silage	Tons	12.9	144	8.3	134	4.0	79
Soybeans	Bu.	15.7	395	21.3	657	28.8	1,230
Dry edible beans	Cwt.	---	---	---	---	---	---
Sugar beets	Tons	---	---	---	---	---	---
Potatoes	Cwt.	.7	105	.3	88	.5	146
Fruit	Tons	1.6	4.8	.6	2	.3	2
Commercial veg.	Cwt.	1.3	138	2.5	407	3.8	778
Alfalfa hay	Tons	35.2	83	26.7	78	11.4	45
Clover-timothy hay	Tons	7.5	9.5	4.2	9	2.3	7
Cropland pasture	Tons Equiv.	2.0	3.0	1.4	---	1.9	6
Sod	Acres	3.1	3.1	3.2	3	3.3	3
Idle cropland	Acres	120.0	---	123.6	---	4.1	---
Total cropland	Acres	272.7	---	259.9	---	132.8	---
Improved pasture	Tons Equiv.	6.6	9.3	12.1	22	9.7	25
Improvable pasture	Tons Equiv.	21.6	14.0	12.6	9	4.0	4
Total pasture	Tons Equiv.	28.2	23.3	24.7	32	13.7	28
Total crop and pasture land	Acres	300.9		284.6		146.5	

[1]1967.

TABLE 3-13--Acreage and Production Changes for the Major Crops between 1967 and 2020

Crop	Acreage Change		Production Change	
	1,000 Acres	Percent	1,000 Units	Percent
Wheat	61.5	38.4	7,334 bu.	126.2
Oats	-34.6	-47.1	1,145 bu.	-26.7
Corn Grain	-71.3	-22.8	10,942 bu.	50.9
Corn Silage	-23.0	-29.1	263 tons	30.1
Soybeans	54.2	20.6	9,445 bu.	141.5
Dry beans	36.4	84.7	1,114 bu.	259.1
Hay	-56.2	-26.6	146 tons	35.4

Subarea 1 contains a large share of the specialty crop acreage, and virtually all dry edible beans are grown there (80,000 acres in 2020). Nearly all of the sugar beets in the Study Area are grown in Subareas 1 and 4. This will continue to be true through the year 2020. However, over the 50-year period, the acreage devoted to sugar beet production in Subarea 1 may contract while that in Subarea 4 may expand.

Livestock projections are based on an extension of historical trends. Livestock feedlots are generally becoming larger and more centralized, and deciding on their locations will become more complicated in the future. Urban expansion into former agricultural areas and the accompanying concentration have exacerbated health and pollution problems associated with livestock and poultry production and with manure disposal. It is expected that regulations concerning waste odor and disposal will soon be forthcoming for feedlots of 1,000 beef cattle or more.

Projected production of the various livestock classes shows that beef, veal, and pork production will rise while egg and milk production will show a temporary decline. Beef and veal constitute the most significant meat production in the Study Area, with a 1967 production of 96.8 million pounds (live weight). This figure is expected to be about 137.5 million pounds (live weight) in 2020 (Table 3-14). Well over half of the current and projected pork production is found in Subarea 4 (Table 3-15). Production of lamb and mutton, as well as poultry and eggs, is

much less significant. Local production of lamb and mutton is less than 5,000 pounds for the Study Area. Broiler and turkey production is 1.3 million pounds, almost entirely in Subarea 4. This is projected to increase to 3.6 million pounds by 2020. Milk production, which serves the major metropolitan areas, is significant, with about 885 million pounds produced in 1967. This is projected to increase to 1.3 billion pounds in 2020. In both 1967 and the projection year about half of this is produced in Subarea 1 (Table 3-16). Egg production is projected to increase by 122 million eggs by 2020 (Table 3-17).

TABLE 3-14--Projections of Beef and Veal, 1967, 1980, and 2020[1]

Subarea	1967	1980	2020
	1,000 lbs. live weight		
1	36.2	40.7	54.4
2	7.8	7.0	6.6
3	1.2	1.1	.6
4	36.6	43.6	54.0
5	14.8	16.1	21.9
TOTAL	96.8	108.5	137.5

[1]Beef and veal represent the sum of beef and dairy steers and heifers, cow-calf operations, feedlot operations, dairy salvage, and dairy veal.

TABLE 3-15--Projections of Pork Production, 1967, 1980, and 2020

Subarea	1967	1980	2020
	1,000 lbs. live weight		
1	3.3	3.9	8.8
2	1.6	1.5	2.4
3	1.6	.8	.4
4	23.8	28.7	59.6
5	5.7	5.3	8.1
TOTAL	36.0	40.2	79.2

TABLE 3-16--Projections of Milk Production
1967, 1980, and 2020

Subarea	1967	1980	2020
	1,000 lbs.		
1	444.6	414.9	747.4
2	84.0	70.4	43.0
3	11.9	10.9	7.3
4	192.9	151.2	190.6
5	151.6	150.2	320.3
TOTAL	885.0	797.6	1,308.6

TABLE 3-17--Projections of Egg Production
1967, 1980, and 2020

Subarea	1967	1980	2020
	1,000,000 eggs		
1	41.5	33.9	64.9
2	22.7	16.3	27.1
3	9.1	5.5	3.5
4	97.3	90.3	188.9
5	21.7	15.7	30.1
TOTAL	192.3	161.7	314.2

The future value of farm production is estimated to indicate the overall magnitude of future agricultural production. Table 3-18 presents the estimated current normal and the 1980 and 2020 projections of value of production. Substantial increases occur between 1967 and 2020 in all subareas with the exception of Subarea 3, the River Rouge Basin, where a reduction of more than 50 percent is indicated. With a very rapid rate of urbanization expected in this area, agricultural activities will be markedly reduced.

TABLE 3-18--Current and Projected Value of Farm Products, 1967, 1980, and 2020[1]

Subarea	1967	1980	2020
	1,000,000 dollars		
1	51.7	60.3	103.2
2	16.4	18.9	22.1
3	5.4	4.7	2.4
4	67.1	72.9	100.8
5	23.6	23.4	34.4
TOTAL	164.2	180.2	262.9

[1]Value of farm products = Output x 1967 normalized prices.

Table 3-19 presents 1967, 1980, and 2020 projections of rural farm employment. Table 3-20 presents estimates of rural farm population for the same years. Because these estimates are based on production, the relationships between subareas for the respective years are similar to value of production.

Rural water requirements are expected to total 30.5 billion gallons by 1980, 16 percent above the 1970 level (Table 3-21). Crop irrigation and non-farm needs constitute 45 percent and 44 percent of requirements, respectively. By the year 2020, total requirements are expected to increase an additional 38 percent over the 1980 level.

Approximately two-thirds of requirements for crop irrigation water stem from sod production; an additional one-fourth of the total is used to irrigate vegetables. Fruits and potatoes are also irrigated, but together constitute only 10 percent of the total.

Rural non-farm requirements are derived from the requirements of rural communities and non-farm households. The major share of rural farm requirements are for livestock water, and by 2020 this will account for some 90 percent of the total.

TABLE 3-19--Current and Projected Rural Farm Employment, 1967, 1980, and 2020[1]

Subarea	1967	1980	2020
	Employees		
1	2,450	2,500	2,010
2	750	740	460
3	200	160	40
4	2,560	2,550	2,300
5	990	860	560
TOTAL	6,950	6,810	5,370

[1]Employment estimates based on agricultural production by production categories assumed hours of labor per man equal to 2,500 for current normal estimates; 2,125 hours/man for 1980; and 2,000 hours/man for 2020.

TABLE 3-20--Current and Projected Rural Farm Population, 1967, 1980, and 2020[1]

Subarea	1967	1980	2020
	Persons		
1	9,050	8,995	6,230
2	2,776	2,646	1,427
3	723	576	125
4	9,461	9,339	7,120
5	3,660	3,109	1,744
TOTAL	25,670	24,665	16,646

[1]Rural farm population estimates are based on ratios between rural farm population and rural farm employment. The estimated current normal ratio is 3.7; 1980--3.6 and 2020--3.1.

TABLE 3-21--Rural Water Requirements, 1970-2020[1]

Item	1967	1980	2000	2020
	billion gallons			
Irrigation	11.9	14.4	17.3	19.4
Rural Farm	2.8	3.0	3.2	3.9
Rural Non-Farm	11.7	13.1	16.4	18.8
TOTAL	26.4	30.5	36.9	42.1

[1]Nine counties only.

PRESENT AND PROJECTED LAND USE

Table 3-22 displays present and projected major land use for 1970 to 2020. Future acreage requirements for urban development and park and game areas are based on county and regional projections. Figure 3-1 shows the general location of this projected development. Cropland, pasture, and forest acreages in Table 3-22 are residually calculated.

The potential effect of the Southeastern Michigan Wastewater Management Survey Scope Study on land use was not considered. The study selected four plans for further consideration. Each plan would have a different effect on land use.

PROJECTED FOREST ACTIVITY

Forested lands and the dependent timber-based industries within the Study Area will contribute less to the economy of the region in the future. This statement does not imply that timber production should be discouraged. In fact, projected national demands allocated to this region indicate that the area should be increasing its production, based on the demand for the material (Table 3-23).

U S DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

HURON CO.

SANILAC CO.

LAPEER CO.

ST. CLAIR CO.

JOINS UPPER RIGHT

JOINS LOWER LEFT

LAPEER CO.

ST. CLAIR CO.

PORT HURON

MACOMB CO.

PONTIAC

INGHAM CO.

LIVINGSTON CO.

OAKLAND CO.

MT. CLEMENS

LAKE ST. CLAIR

ST. CLAIR RIVER

DETROIT RIVER

MICHIGAN
UNITED STATES
CANADA
ONTARIO

ANN ARBOR

DETROIT

WASHTENAW CO.

JACKSON CO.

YPSILANTI

WAYNE CO.

HILLSOALE CO.

LENAWEE CO.

ADRIAN

MONROE

MONROE CO.

LAKE ERIE

FULTON CO.

MICHIGAN
OHIO

N

LEGEND

STATE LINE
COUNTY LINE
STREAM, LARGE
STREAM, SMALL
LAKE
HIGHWAY, INTERSTATE
HIGHWAY, U S
HIGHWAY, STATE
OTHER HIGHWAYS
CITY BOUNDARY
STUDY AREA BOUNDARY
SUBAREA BOUNDARY

PARKS AND GAME AREA
1980
2000
2020

URBAN
1980
2000
2020

SCALE 1/615,150
SCALE 1 0 1 2 3 4 5 6 7 8 9 MILES

FIGURE 3-1

SOUTHEASTERN MICHIGAN
WATER RESOURCES STUDY

MICHIGAN

URBAN AND PARKS AND GAME AREA
PROJECTED DEVELOPMENT 1980, 2000, AND 2020

U.S. DEPARTMENT OF AGRICULTURE
Economic Research Service, Forest Service
and Soil Conservation Service

4-15-71
S.R.-32,109

SOURCE
SCS DRAWING NUMBER S.R.-31,919 I AND
INFORMATION FROM FIELD TECHNICIANS

POLYCONIC PROJECTION

USDA-SCS-LINCOLN, NEBR. 1974

TABLE 3-22--Present and Projected Major Land Use

Land Use	1970	1980	2000	2020
	1,000 Acres			
Subarea 1				
Cropland[1]	606.8	592.3	560.0	520.3
Pasture	31.2	29.3	27.0	24.5
Forest	130.1	121.6	117.4	113.5
(Parks & Game Areas)	(2.0)	(8.9)	(24.6)	(30.4)
Urban	33.1	57.1	95.6	140.4
(Urban Forest)[2]	--	(1.8)	(4.7)	(7.5)
Water	1.0	1.0	1.0	1.0
Other	36.8	37.7	38.0	39.3
(Rural Transportation)	(23.0)	(25.4)	(28.0)	(30.8)
TOTAL	839.0	839.0	839.0	839.0
Subarea 2				
Cropland[1]	224.9	194.5	154.0	112.9
Pasture	9.6	8.2	6.4	4.7
Forest	74.0	64.8	58.1	52.3
(Parks & Game Areas)	(7.0)	(12.7)	(20.9)	(29.0)
Urban	131.9	183.1	234.0	284.1
(Urban Forest)[2]	--	(4.9)	(9.4)	(14.0)
Water	11.8	12.0	12.0	12.0
Other	34.2	23.8	21.9	20.4
(Rural Transportation)	(19.9)	(19.1)	(16.8)	(14.5)
TOTAL	486.4	486.4	486.4	486.4
Subarea 3				
Cropland[1]	63.4	25.0	13.5	2.0
Pasture	.9	.7	.4	.1
Forest	59.4	53.2	48.3	43.5
(Parks & Game Areas)	(4.0)	(8.5)	(12.0)	(15.5)
Urban	303.2	353.4	377.5	401.5
(Urban Forest)[2]	--	(4.2)	(6.6)	(9.0)
Water	3.0	3.0	3.0	3.0
Other	34.7	29.3	21.9	14.5
(Rural Transportation)	(15.2)	(14.2)	(12.1)	(10.0)
TOTAL	464.6	464.6	464.6	464.6

TABLE 3-22 (continued)--Present and Projected Major Land Use

Land Use	1970	1980	2000	2020
	1,000 Acres			
Subarea 4				
Cropland[1]	750.6	728.7	594.4	459.4
Pasture	23.3	21.9	18.5	15.2
Forest	133.1	128.2	116.6	105.0
(Parks & Game Areas)	(7.0)	(10.7)	(39.2)	(59.3)
Urban	53.8	83.0	230.5	378.8
(Urban Forest)[2]	--	(2.2)	(12.8)	(23.4)
Water	7.2	7.2	7.2	7.2
Other	53.4	52.4	54.2	55.8
(Rural Transportation)	(23.4)	(20.8)	(19.4)	(18.0)
TOTAL	1,021.4	1,021.4	1,021.4	1,021.4
Subarea 5				
Cropland[1]	272.7	259.9	196.5	132.8
Pasture	28.2	24.7	19.2	13.7
Forest	150.0	147.0	140.5	134.0
(Parks & Game Areas)	(36.0)	(54.7)	(90.4)	(124.0)
Urban	48.2	72.8	153.3	231.7
(Urban Forest)[2]	--	(2.0)	(8.0)	(14.0)
Water	26.6	26.6	26.6	26.6
Other	55.4	50.1	45.0	42.3
(Rural Transportation)	(23.6)	(23.4)	(23.3)	(23.2)
TOTAL	581.1	581.1	581.1	581.1

TABLE 3-22 (continued)--Present and Projected Major Land Use

Land Use	1970	1980	2000	2020
Region	1,000 Acres			
Cropland[1]	1,918.4	1,800.5	1,518.4	1,227.4
Pasture	93.2	84.7	71.5	58.2
Forest	546.6	514.8	480.9	448.3
(Parks & Game Areas)	(56.0)	(95.5)	(187.1)	(258.2)
Urban	570.2	749.4	1,090.9	1,436.5
(Urban Forest)[2]	--	(15.1)	(41.5)	(67.9)
Water	49.6	49.8	49.8	49.8
Other	214.5	193.3	181.0	172.3
(Rural Transportation)	(105.1)	(102.9)	(99.6)	(95.7)
TOTAL	3,392.5	3,392.5	3,392.5	3,392.5

[1]Includes active and idle cropland.
[2]Projected urban forest land only. Does not include present urban forest land.

TABLE 3-23--Projected Supply and Demand for Timber Production

	1980	2000	2020
	(1,000 cubic feet)		
Supply	3,058	3,267	3,367
Demand	11,000	21,000	24,000

A portion of the region, particularly the northern half of Subarea 1, will continue as an important timber-producing and manufacturing area. However, local residents indicate that Metropolitan Detroit and Pontiac residents are already purchasing land in this area for recreational purposes.

CHAPTER IV

Land and Water Resource Problems

CHAPTER IV

LAND AND WATER RESOURCE PROBLEMS

Intensive use of the land and water resources in southeastern Michigan is creating a variety of problems in both the rural and urban areas. These problems are becoming more severe as the demand for land and water increases. This chapter covers the current and expected short-term resource problems as well as the problems that projected development would cause by the year 2020.

LAND USE

Agriculture

Both the quantity and the quality of the agricultural land resource in the Study Area are decreasing due to urban expansion. Chapter III states that only 20,000 acres of idle or surplus cropland are expected to remain by 2020. In addition, the total supply of cropland and pastureland is projected to decrease approximately 725,000 acres, or 34 percent.

The anticipated loss of prime agricultural land is perhaps a more critical problem than the decrease in total supply of cropland. Prime agricultural land is unique because of its high crop yields. This land is therefore important to the overall welfare of the region, the State, and the nation. Over 80,000 acres of prime agricultural land are projected to be used for nonagricultural development by the year 2020 (Figure 4-1). Most of this loss is expected in Subarea 4. Scattered losses will take place in the other subareas.

Subarea 1 is predominantly agricultural. Cropland and pastureland total 638,000 acres. Of this, 230,000 acres, or 36 percent, are considered prime agricultural land. The urban projection map indicates that urban development will not be a major threat to this valuable resource. However, scattered residential and industrial development could significantly reduce the prime agricultural acreage.

PRIME CROPLAND USED FOR HIGHWAY CONSTRUCTION - MONROE COUNTY.

Approximately 36,000 acres of cropland in northern Macomb County, in Subarea 2, are considered prime. Urban development in the vicinity of Armada is expected to take some prime land.

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MICHIGAN
UNITED STATES
CANADA
ONTARIO

N

LEGEND

- STATE LINE
- COUNTY LINE
- STREAM, LARGE
- STREAM, SMALL
- LAKE
- HIGHWAY, INTERSTATE
- HIGHWAY, U.S.
- HIGHWAY, STATE
- OTHER HIGHWAYS
- CITY BOUNDARY
- BASIN BOUNDARY
- STUDY AREA BOUNDARY
- SUBAREA BOUNDARY
- PRIME AGRICULTURE LAND
- PRIME RECREATION LAND
- PROJECTED LOSS OF PRIME AGRICULTURE LAND
- PROJECTED LOSS OF PRIME RECREATION LAND

SCALE 1/615,150

SCALE 1 0 1 2 3 4 5 6 7 8 9 MILES

POLYCONIC PROJECTION

SOURCE
SCS DRAWING NUMBER 5,R-31,918 AND
INFORMATION FROM FIELD TECHNICIANS

FIGURE 4-1

SOUTHEASTERN MICHIGAN WATER RESOURCES STUDY

MICHIGAN

PROJECTED LOSS OF PRIME AGRICULTURE AND RECREATION LANDS - 1970 - 2020

U.S. DEPARTMENT OF AGRICULTURE
Economic Research Service, Forest Service
and Soil Conservation Service

5,R-32,938

USDA-SCS-LINCOLN, NEBR. 1974

Although primary land use in Subarea 3 is urban development, there are still approximately 4,000 acres of prime agricultural land north of Denton in Wayne County. However, land use projections for the year 2000 indicate that the prime agricultural land will be lost to urban development.

Approximately half of the prime agricultural land in the region is in Subarea 4. Most of this land is in a band approximately 10 miles wide, running north and south through the center of the subarea. Prime agricultural land is also located in areas of central Monroe and southern Wayne Counties. Urban pressures on this land will become critical by the year 2000. Anticipated development along U.S. 23 will encroach on prime agricultural land in the northwest corner of Monroe County. Development in the southern part of Monroe County is starting to move into the prime agricultural land. Most of the prime agricultural land in Wayne County in the subarea is projected to be developed for urban use by the year 2000.

PRIME ORCHARD LAND USED FOR URBAN DEVELOPMENT - MACOMB COUNTY.

By the year 2020, minor conflicts are projected between agricultural land and urban development in Lenawee County. Development along U.S. 23 is expected to have made major inroads into agricultural land in Monroe and Washtenaw Counties. In Monroe County approximately 20,000 acres of prime agricultural land are expected to be converted to urban development.

Approximately 3,000 acres of prime agricultural land are located in Subarea 5. A comparison of the urban projection for 1980 and the prime land map reveals no major conflicts. By the year 2000, a conflict is foreseen between prime agricultural land and recreation development in Washtenaw County. In addition, a small amount of prime agricultural land in the lower part of the subarea in Wayne County is projected to be used for urban development.

Urban

In the past urban development has resulted in a dramatic deterioration of the natural or rural environment. Urban land use has created many severe environmental problems, such as noise, heat, air pollution, and the absence of open space. If this continues without proper planning, the projected development of almost 900,000 acres of land that is now open space will have a devastating impact on the environment of southeastern Michigan.

The urban dweller is subjected to much more noise than is the rural dweller. Outdoor noises come from air and surface transportation, construction projects, and industrial sites. The traffic on a busy city street may reach 90 decibels.

Air temperature is another problem in urban communities, where pavement and buildings absorb much heat. On the average, cities have a temperature of 0.9^{o} to 1.4^{o}F higher than the surrounding countryside. Densely populated areas may be many degrees warmer.

Air pollution is, for the most part, a phenomenon of urban living. Modern technology uses enormous volumes of oxygen and emits large amounts of carbon dioxide and other gases. Dust and odors add to the problem.

Perhaps the most serious environmental problem in a poorly planned urban area is the stark urban landscape. Trees are not planted to shade busy avenues at the same rate that they are felled for street widening. The economic pressure to build parking lots is greater than the social pressure to preserve the open lot as a play area.

Forest

Many forest land resource problems are basinwide in scope. The problems are varied and include the risk of fire, the lack of forest management, the prevalence of forest insects and disease, and the lack of tax incentives to retain land in commercial forest use.

In a heavily populated area such as southeastern Michigan, the risk of wildfire in forested lands is always great. The large areas of idle land awaiting development provide flashy fuels. If these areas are adjacent to coniferous plantations, the potential exists for a fast-moving, devastating fire. In addition, suburban development in forested areas increases the potential damages.

Landowners generally do not look upon their wooded acres as being a potentially productive part of their ownership. This prevailing attitude often hinders the implementation of good forest land management practices. It is difficult to change this attitude even though it is becoming clearly evident that the nation must rely more heavily on private nonindustrial woodlands to help meet projected demands for raw material.

Woodland owners in the urban expanding areas pose a different problem. Many owners consider their forested acres as worthwhile investments only for the increased valuation of such lands because of their potential for subdivisions. Other landowners are highly interested in maintaining forested tracts in an undeveloped state because of aesthetic and environmental interests, but are unable to bear the economic burden of high taxes based on market values. Both groups are often reluctant to practice any forest management measures because of the short-term aesthetic impairment associated with these measures.

Certain forest insects and various diseases of trees are present within the Study Area and the potential for a serious outbreak does exist. Dutch elm disease, which decimated large numbers of American elm trees and is still active, is a stark reminder of the threat posed by the various insects and diseases.

The potential for a serious infestation by the gypsy moth is the major insect problem at present. It has been found in parts of lower Michigan. This forest pest is a hardwood defoliator which has caused extensive damage to forest resources in the eastern United States. Oaks are the preferred host.

Diseases present in Christmas tree plantations include Lophodermium and Brown Spot Needle Case, which do not kill the trees but make them non-marketable. Oak wilt is also present primarily in red oaks. Several diseases associated with the highly valued species of black walnut and butternut are present, including Walnut Anthracnose and Walnut Dieback.

The current method of land taxation in Michigan is based on the land's potential for development. This valuation is generally made on the basis of current sale values of comparable properties rather than on the productive potential of the land in its current use. In an urban expanding area such as southeastern Michigan, this type of taxation discourages the retention of land in commercial forest use.

The number of acres of forest land in the sawtimber size class has decreased significantly in the past 10 years. This reduction is principally a result of heavy cutting in this age class. In addition, very little management has been directed towards increasing growth in poletimber stands to promote their development into the sawtimber size class. A shortage of sawtimber is projected for the next 20 years, until this growth is realized.

Forest land management problems vary from subarea to subarea. This is due mainly to the differences in land use projections and soil conditions.

Few forest land use conflicts are noted in Subarea 1. However, indications are that some forest land acreage is being bought for purely speculative reasons, i.e., the buyers are anticipating urban or recreational expansion. Small farm woodlots are also being purchased for individual summer homes. If this trend continues, the commercial forest land base will be reduced, with a resultant loss in timber productions.

An opportunity exists in this subarea to increase commercial timber production by applying accelerated land treatment practices.

Present uses of the resource are varied in Subarea 2, but one factor is dominant in determining the specific use: the proximity of the resource to the urbanized areas. As the urban areas expand and encroach upon the formerly rural environs, the forest resource becomes a prime target for developers and forested land demands a higher price per acre than open land. The uses of forested lands which may undergo urban expansion also change as landowners merely hold onto their acreage until prices rise. Forest land management practices are almost nonexistent in this situation because they often result in temporary disturbances which the landowner feels could lower the value of his acreage. Thus the immediate result of this impending urbanization upon the forest resource is the lack of good forest land management. Therefore these areas contribute only incidentally as greenbelts and wildlife habitat.

Forest land managed for wildlife habitat is only on an incidental, individual basis. There are no State game areas within Subarea 2. Those acres in Forest Land Suitability Categories 4 and 5 are valuable wildlife habitat, but urban expansion is projected for these areas by the year 2020. Urban expansion is expected to engulf 22,000 acres of forest land by the year 2020.

Urban development is projected to require 16,000 acres of forest land in Subarea 3 by the year 2020 and this development will certainly preclude any commercial forestry activity. Without some form of urban forestry planning, few forested tracts will be retained as greenbelts and nature study areas.

Major recreation and wildlife areas in Subarea 4 are projected to expand from 7,000 acres at present to 59,300 acres by the year 2020. The Onsted and Sharonville State Game Areas and Hayes State Park are among the larger units proposed for expansion, primarily on soils in Forest Land Suitability Category 2. This shift in forest land use and ownership will result in reducing the commercial forest land base available for timber production.

Urban expansion is projected to take place primarily in the eastern half of Subarea 5, and expansion of existing recreation areas is anticipated for the western half. This development poses problems similar to those identified in Subareas 3 and 4.

Recreation

The Bureau of Outdoor Recreation will publish the Recreation Appendix for the Southeastern Michigan Water Resources Study at a later date. This report focuses on the projected loss of prime recreation land to other land uses.

This region is actively growing in number of people and in land used for development. Agricultural and forested land around suburban Detroit is being lost as outward expansion of homes, industries, and utilities continues. Ann Arbor, Pontiac, and some smaller communities are also taking good land for urban use. In some cases prime recreation land will also be lost.

A comparison of the urban projection map and the prime land map identifies specific locations where future urban development will deplete prime recreation resources in southeastern Michigan (Figure 4-1). Most of the problem areas are in Subareas 2 and 5.

Competition for land is apparent in Subarea 2. A conflict between urban development and prime recreation land is expected by the year 2020. Presently the urban development is concentrated in the southern half of the subarea. Large areas of designated prime recreation land, totaling 36,000 acres, are well distributed in the northern and western parts.

Projected urban development in Oakland County will result in a loss of prime recreation land by the year 2000 in Subarea 5. The urban expansion of Chelsea, in Washtenaw County, is also projected to encroach upon prime recreation land.

Fish and Wildlife Habitat

The U.S. Fish and Wildlife Service will publish a Fish and Wildlife Appendix at a later date which will contain species populations and habitat analyses. This section of the U.S. Department of Agriculture report will examine only general fish and wildlife habitat problems.

Most fish and wildlife habitat problems in the Study Area are the result of changed land use, maximum open space farming, and loss of streambank vegetation. All of these problems exist throughout the region in varying degrees.

Possibly the most serious problems in preserving fish and wildlife habitat are those associated with land use changes. Cropland, pasture-land, forest land, and idle cropland acreages will all decrease. The latter two are perhaps the most significant for habitat preservation.

By 2020, 97 percent of idle cropland (641,200 acres) is projected to be in agricultural or urban use. Little immediate change is anticipated, but between 1980 and 2020 major shifts will take place. Only Subarea 4 will show an increase in the acreage in the immediate future, from 138,000 to 184,000 acres (Figure 4-2).

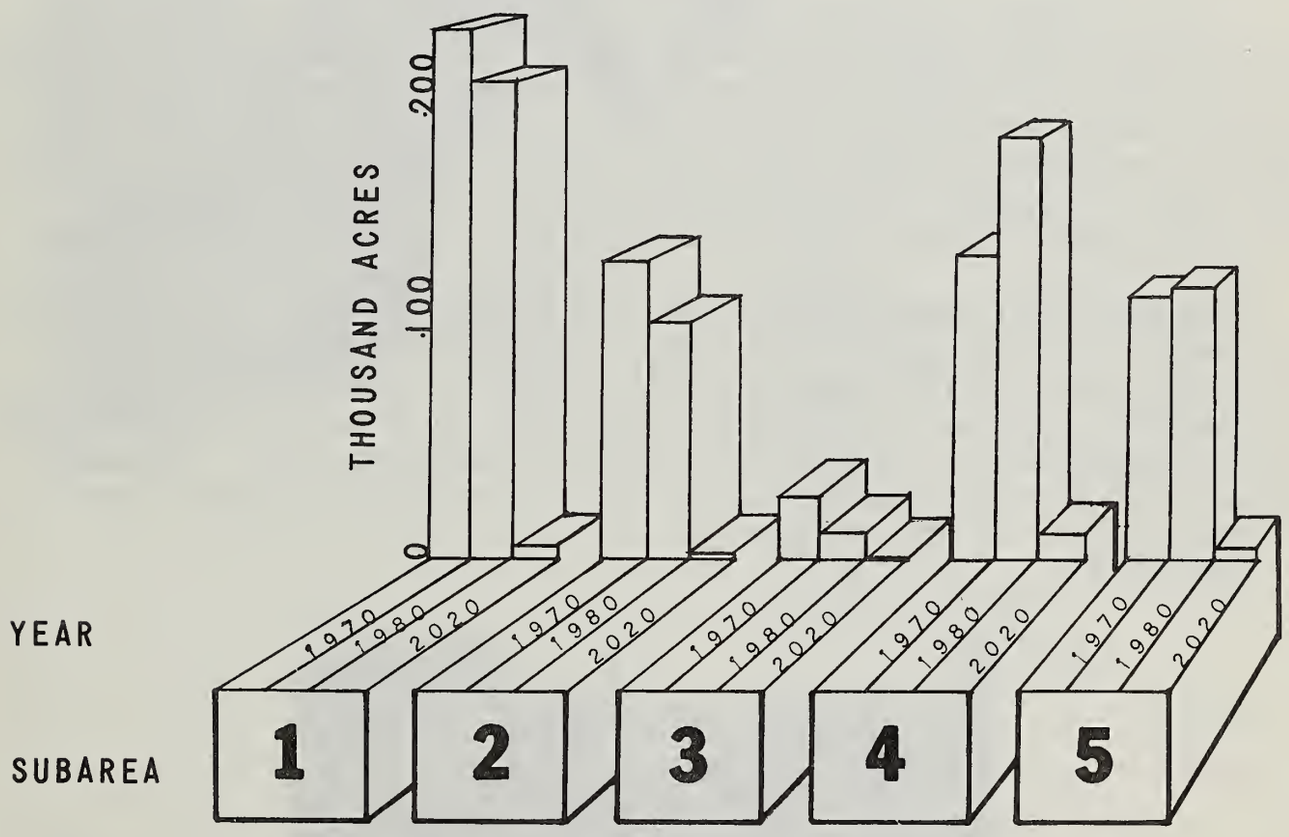

Figure 4-2 Idle Cropland Trends
Southeastern Michigan Water Resources Study

Loss of the idle cropland poses an enormous threat to wildlife populations since this land provides habitat for ring-necked pheasant, cottontail rabbit, quail, mourning dove, and red fox. Wildlife populations will decline as clean farming becomes more widespread and destroys necessary habitat.

A major change in forest land wildlife habitat also will occur. During the next 50 years about 30,000 acres of forest land wildlife habitat will be lost because of urban development. Another 70,000 acres of rural forest land wildlife habitat are expected to become urban forest wildlife habitat.

Urban development creates many changes in the species of wildlife present. As habitat is destroyed there is also a reduction in species that need larger areas and cannot coexist with humans. Valuable wetlands are often lost as urban expansion moves through an area.

The maximum open space farming problem exists primarily in areas of prime and other good agricultural land. To maximize the return from their land, some landowners farm as many acres as possible to increase production and operate machinery efficiently. Fence lines, hedgerows, marshes, and small woodlots have been eliminated; fields are plowed to the edges of streams, ditches, and property lines. This eliminates wildlife food and cover, forcing much of the wildlife out of the area.

Upland small game species such as pheasant, rabbit, and quail are affected, as is big game such as deer. The problem is getting more extensive and with the higher prices for agricultural commodities the problem will continue to increase. Existing and potential maximum open space farming areas are shown in Table 4-1 and Figure 4-3. Lenawee, Monroe, and Sanilac Counties have extensive areas that exhibit the characteristics of this problem.

URBAN DEVELOPMENT AND WASTE DISPOSAL MEANS DEATH TO THIS WETLAND

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BLACK RIVER BASIN

APPLEGATE

CROSWELL

YALE

BROCKWAY

LAPEER CO.

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UNITED STATES
CANADA
ONTARIO

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MILFORD

HURON RIVER BASIN

DEXTER

CHELSEA

ANN ARBOR

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NORTHVILLE

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LENAWEE CO.

ADRIAN

RIVER RAISIN BASIN

MONROE

MONROE CO.

MONROE LASALLE TWP

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MICHIGAN
OHIO

LAKE ERIE

DETROIT RIVER

JOINS LOWER LEFT

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ALMONT

LESTER LE

BELLE RIVER BASIN

MEMPHIS

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ST. CLAIR

ST. CLAIR RIVER

MARINE CITY

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ARMADA

LAKE ORION

MACOMB CO.

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PONTIAC

ROCHESTER

MOUTH

MT. CLEMENS

LAKE ST. CLAIR

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UNITED STATES
CANADA
ONTARIO

N

LEGEND

- STATE LINE
- COUNTY LINE
- STREAM, LARGE
- STREAM, SMALL
- LAKE
- HIGHWAY, INTERSTATE
- HIGHWAY, U.S.
- HIGHWAY, STATE
- OTHER HIGHWAYS
- CITY BOUNDARY
- BASIN BOUNDARY
- STUDY AREA BOUNDARY
- SUBAREA BOUNDARY
- AGRICULTURE CONFLICTS WITH TOP QUALITY FISH STREAMS
- URBAN DEVELOPMENT CONFLICTS WITH TOP QUALITY FISH STREAMS
- AGRICULTURE CONFLICTS WITH WILDLIFE HABITAT
- URBAN DEVELOPMENT CONFLICTS WITH WILDLIFE HABITAT

SCALE 1/615,150

SCALE I 0 1 2 3 4 5 6 7 8 9 MILES

SOURCE:
SCS DRAWING NUMBER 5,R-31,919 AND
INFORMATION FROM FIELD TECHNICIANS

POLYCONIC PROJECTION

USDA-SCS-LINCOLN NEBR. 1970

FIGURE 4-3

SOUTHEASTERN MICHIGAN WATER RESOURCES STUDY

MICHIGAN

EXISTING AND POTENTIAL URBAN AND AGRICULTURE CONFLICTS WITH TOP QUALITY FISH AND WILDLIFE HABITAT

U.S. DEPARTMENT OF AGRICULTURE

Economic Research Service, Forest Service
and Soil Conservation Service

2-20-14
5,R-32,941

TABLE 4-1--Existing Agricultural and Urban Conflicts with Wildlife Habitat

County	Location	Type of Conflict	Habitat Affected
Lapeer	SE Corner	Clean farming	Small Game
Lenawee	NW Corner-Lake area	Urban development	Waterfowl
Lenawee	East half	Clean farming	Small Game
Livingston	South Quarter-Lake area	Urban development	Waterfowl, Big Game
Macomb	North half	Clean farming	Small Game
Macomb	Mt. Clemens to Anchorville	Urban development	Waterfowl
Macomb	NW Corner-Lake area	Urban development	Waterfowl
Monroe	Huron River Mouth area	Urban development	Waterfowl
Monroe	West half and NE Corner	Clean farming	Small Game
Monroe	Lakeshore South of Monroe	Urban development	Waterfowl
Oakland	NE Corner-Lake area	Urban development	Waterfowl
Oakland	NE Corner	Clean farming	Small Game
Oakland	SW Corner	Clean farming	Small Game
Oakland	West of Pontiac-Lake areas	Urban development	Waterfowl, Big Game
Sanilac	West of Black River	Clean farming	Small Game
St. Clair	West Two-thirds	Clean farming	Small Game
St. Clair	Anchorville to Pearl Beach	Urban development	Waterfowl
Washtenaw	NW Corner-Lake area	Urban development	Waterfowl
Washtenaw	Ann Arbor-Ypsilanti	Urban development	Waterfowl, Big Game
Washtenaw	SE Corner	Clean farming	Small Game
Wayne	Western edge	Urban development	Waterfowl, Big Game

Another major problem concerning fish and wildlife habitat is the loss of natural streambank vegetation. This vegetation consists of a mixture of woody and non-woody plants growing along streams, which helps prevent erosion and sedimentation, lowers water temperature, provides food and cover to fish and wildlife, absorbs noise, reduces dust, reduces upland runoff of pollutants, reduces wind velocity, and enhances aesthetic quality.

Conflicts result in both agricultural and urban areas. In agricultural areas streambank vegetation is lost when these areas are cleared for farming, when livestock grazing is permitted, or when barnyard runoff pollutes the streams. In urban areas vegetation is destroyed when streams are straightened to allow faster runoff, when backyards are extended to the streams with well kept grass, and when the streams are polluted with residential or industrial waste.

The loss of fish and wildlife is a continuous early warning system which can alert man to the first signs of danger in the environment. Any rapid, major change in species populations should be a warning to search out the cause. Also, the variety of species which exists in a given area may be a significant indicator of environmental problems.

VEGETATION ALONG THE STREAMS
CANNOT BE MAINTAINED UNDER
THESE CONDITIONS

WATER POLLUTION

The U.S. Environmental Protection Agency will publish a Water Pollution Appendix at a later date. This section of the U.S. Department of Agriculture report examines only general water pollution and other water quality problems.

Many sources of chemicals and other materials affect the quality of water in southeastern Michigan. These include contaminants in wastewater runoff from municipal areas, inadequately treated sewage, runoff from agricultural cropland, and runoff from agricultural livestock operations. A major source of pollutants is erosion, both from agricultural lands and from developing urban areas. Many contaminants are carried dissolved in runoff water and many others are carried adsorbed to surfaces of sediment particles in surface water runoff.

The following summarizes general water quality problems in the major tributaries in southeastern Michigan:

1. Detroit River--Water quality in the Detroit River is substandard, particularly from the junction with the Rouge River downstream. This reach receives effluents from seven sewage treatment plants, including the City of Detroit's main plant, which serves 90 percent of the area's population, 29 industrial plants, storm water overflows, and tributary discharges. This reach displays excessive levels of coliform, phenols, toxic substances, nutrients, resins, and suspended solids. Objectionable color, oil, and debris are also present.

2. River Raisin--Surface water in the basin is high in nutrients and dissolved and suspended solids, with concentrations increasing toward the mouth of the river. The lower three-mile reach is of severe substandard quality, and there are many other reaches of substandard quality. The river experiences severe oxygen depletion, very high coliform densities, and excessive concentrations of residues, toxics, nutrients, and suspended and dissolved solids.

3. Huron River--The main stem of the Huron River downstream from Ann Arbor is considered substandard because of excessive nutrient concentrations. Furthermore, a large number of reaches in the basin are substandard in one or more quality parameters in addition to nutrients.

4. Rouge River--The Rouge River is wholly contained within the intensely urbanized and industrialized Detroit metropolitan area. Twenty-eight industries use the basin's surface waters for waste assimilation. There are no municipal treatment plant discharges in the Rouge River Basin. The lower 15 miles of the river and the middle Rouge are severely degraded. High nutrient levels are common in the upper portions of the Rouge River.

5. Clinton River--The Clinton River is seriously degraded. During the summer, natural streamflows are very low and waste treatment plant effluents constitute a major portion of streamflow. Nutrients and dissolved minerals are a particular problem in many reaches.

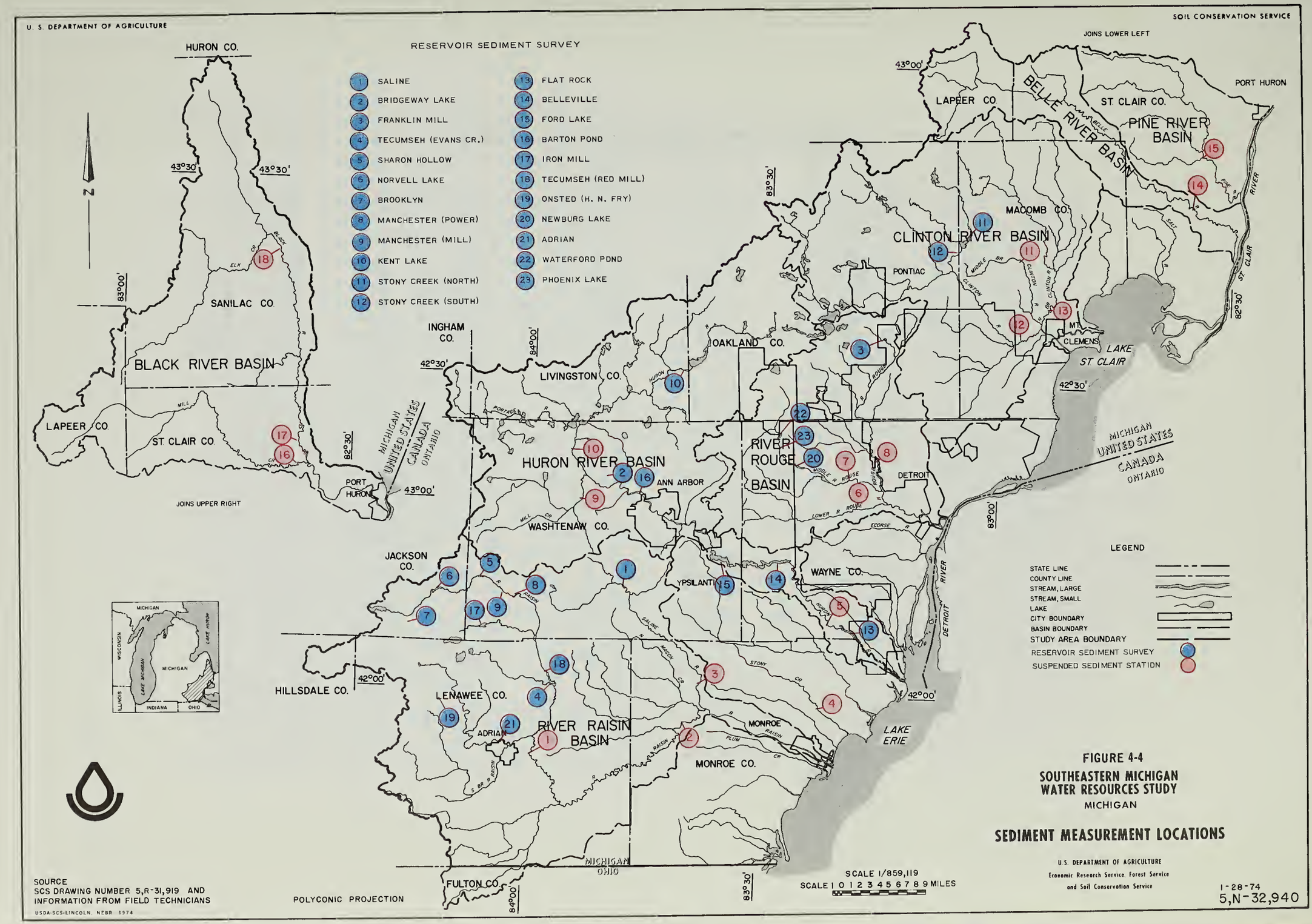
6. Belle, Pine, and Black Rivers--Water quality in these rivers is generally good with the exception of scattered reaches where quality is substandard, generally due to excessive nutrients.

Numerous water quality parameters are currently being measured in southeastern Michigan. Data on oxygen demands, chemical constituents, and suspended sediment is available for several stations. Table 4-2 summarizes major water quality parameters and their observed ranges in variation for the 4-year period from January 1964 to December 1967.

A special sampling program was conducted to obtain supplementary data on suspended sediment in southeastern Michigan. Sampling was done periodically at 18 sampling stations for a period of 18 months. Average suspended sediment concentrations were found to range from 16 to 27 parts per million. Individual samples had a range from a few parts per million to more than 100 parts per million. The locations of the sampling stations are shown in Figure 4-4. Table 4-3 summarizes the average sediment concentrations.

TABLE 4-2--The Range of Observed Variations in Water Quality Parameters by Major Tributaries, 1964-1967

Tributary	Dissolved Oxygen(mg/l) 1	Biological Oxygen Demand (mg/l) 2	Chemical Oxygen Demand(mg/l) 3	I 4	Conductance (Micro Mhos) 5	Nitrate(NO_3) (mg/l) 6	Chloride (mg/l) 7	Phospahte(PO_4) (mg/l) 8	Total Coliform Counts/100ml 9	Fecal Coliform Counts/100ml 10	Suspended Sediment (parts per million)
Pine River	4.0 - 13.0	1.0- 11.2	3.0- 52.0	7.5- 8.5	240- 1300	0.- 8.0	5.0- 340.0	0- 0.90	100- 9300	100- 3000	3-252
Belle River	2.5- 13.0	1.4- 11.2	3.0- 50.0	7.5- 8.5	48- 1020	0- 19.0	21.0- 138.0	0- 0.75	100- 240,000	100- 1500	3-312
Clinton River	0.4 11.0	1.6 25.0	21.0 80.0	7.2 8.0	360- 1200	0- 10.0	28.0- 274.0	0- 14.0	200- $1.4x10^6$	100- 12,000	7-254
River Rouge	1.0 12.6	1.6- 16.0	4.0 85.0	6.5- 8.5	220 1300	0- 5.8	4.0- 2120	0- 2.6	100- 460,000	300- 13,000	9-150
Huron River	5.0 14.5	2.8- 12.8	17.0 - 44.0	7.8 8.8	480 830	0- 5.0	28.0 58.0	0- 2.1	200- 240,000	100 600	8-100
Raisin River	0- 17.0	1.0- 22.8	13.0- 90.0	7.1- 8.7	290- 690	0- 28.0	9.0- 48.0	0- 1.5	300- $1.4x10^6$	100 3000	9-178


U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
RESERVOIR SEDIMENT SURVEY
1 SALINE
2 BRIDGEWAY LAKE
3 FRANKLIN MILL
4 TECUMSEH (EVANS CR.)
5 SHARON HOLLOW
6 NORVELL LAKE
7 BROOKLYN
8 MANCHESTER (POWER)
9 MANCHESTER (MILL)
10 KENT LAKE
11 STONY CREEK (NORTH)
12 STONY CREEK (SOUTH)
13 FLAT ROCK
14 BELLEVILLE
15 FORD LAKE
16 BARTON POND
17 IRON MILL
18 TECUMSEH (RED MILL)
19 ONSTED (H. N. FRY)
20 NEWBURG LAKE
21 ADRIAN
22 WATERFORD POND
23 PHOENIX LAKE
HURON CO.
SANILAC CO.
BLACK RIVER BASIN
LAPEER CO.
ST. CLAIR CO.
JOINS UPPER RIGHT
JOINS LOWER LEFT
PORT HURON
INGHAM CO.
LIVINGSTON CO.
OAKLAND CO.
MACOMB CO.
CLINTON RIVER BASIN
PONTIAC
MT. CLEMENS
LAKE ST CLAIR
PINE RIVER BASIN
BELLE RIVER BASIN
HURON RIVER BASIN
ANN ARBOR
WASHTENAW CO.
RIVER ROUGE BASIN
DETROIT
WAYNE CO.
YPSILANTI
JACKSON CO.
HILLSDALE CO.
LENAWEE CO.
ADRIAN
RIVER RAISIN BASIN
MONROE
MONROE CO.
LAKE ERIE
FULTON CO.
MICHIGAN
OHIO
INDIANA
ILLINOIS
WISCONSIN
LAKE MICHIGAN
LAKE HURON
MICHIGAN
UNITED STATES
CANADA
ONTARIO
43°30'
83°00'
42°30'
84°00'
82°30'
43°00'
LEGEND
STATE LINE
COUNTY LINE
STREAM, LARGE
STREAM, SMALL
LAKE
CITY BOUNDARY
BASIN BOUNDARY
STUDY AREA BOUNDARY
RESERVOIR SEDIMENT SURVEY
SUSPENDED SEDIMENT STATION
SOURCE
SCS DRAWING NUMBER 5,R-31,919 AND
INFORMATION FROM FIELD TECHNICIANS
USDA-SCS-LINCOLN, NEBR. 1974
POLYCONIC PROJECTION
SCALE 1/859,119
SCALE 1 0 1 2 3 4 5 6 7 8 9 MILES
FIGURE 4-4
SOUTHEASTERN MICHIGAN
WATER RESOURCES STUDY
MICHIGAN
SEDIMENT MEASUREMENT LOCATIONS
U.S. DEPARTMENT OF AGRICULTURE
Economic Research Service, Forest Service
and Soil Conservation Service
1-28-74
5,N-32,940

Suspended sediment concentrations of 16 to 27 parts per million would not ordinarily be a water quality problem. At levels of 100 parts per million, however, discoloration of the water becomes noticeable and excessively high levels of other contaminants, adsorbed to the sediment particles, may be present. The difficulty with periodic collection of suspended sediment samples is that durations of high sediment concentration cannot be determined and peaks of concentrations are often missed.

Data collected for the 18 sampling stations correlates with the suspended sediment data shown in Table 4-2. This data, collected at an earlier date by the Michigan Department of Natural Resources, shows suspended sediment concentrations ranging from a few parts per million to about 100 parts. However, in several samples concentrations reached more than 200 parts per million.

Fertilizers applied to the land are a source of pollution to the water resources in southeastern Michigan. The more soluble components of fertilizer are carried dissolved in runoff water. The less soluble substances, such as phosphates, are carried by sediment particles. The acreage of land fertilized each year has declined. However, the rate of fertilizer application has increased and total fertilizer use has increased. Table 4-4 summarizes fertilizer use and acres fertilized in southeastern Michigan.

TABLE 4-3--Average Concentration of Suspended Sediment
(Based Upon Periodic Sampling at 18 Stations)

Sampling Station	Tributary	Suspended Sediment (Parts per Million)	Sampling Station	Tributary	Suspended Sediment (Parts per Million
1	Upper Raisin	19	10	Upper Huron	16
2	Middle Raisin	20	11	Upper Clinton	20
3	Saline River	20	12	Lower Clinton	27
4	Stony River	21	13	N. Br. Clinton	21
5	Lower Huron	19	14	Belle River	24
6	Lower Rouge	20	15	Pine River	21
7	Middle Rouge	20	16	Mill Cr. (Black R.)	21
8	Upper Rouge	24	17	Lower Black	20
9	Mill Creek	18	18	Upper Black	21

TABLE 4-4--Estimated Commercial Fertilizer Used and Acres Fertilized (1954-1969)[1]

	1954	1959	1964	1969
Acres Fertilized	832,000	852,000	774,000	435,000
Fertilizer Used (Tons)	104,000	115,000	117,000	124,000
Average Rate of Application (lbs.per acre)	250	270	304	569

[1]Estimate based upon Census of Agriculture data.

Problems from livestock waste will increase during the next 50 years. Increasing numbers of beef cattle are being fed under concentrated and confined conditions. Poultry production and other livestock operations are tending toward centralization. This trend allows for more economical operations, but increases the problems with animal waste management.

Beef and dairy cattle produce, on the average, 12 to 18 tons of waste per head per year. Solids constitute 70 percent of this and liquids 30 percent. The yearly waste from each animal includes about 150 pounds of nitrogen, 36 pounds of phosphorus, and 120 pounds of potassium. Large quantities of these chemicals, as well as coliform bacteria, enter the local streams in runoff water and on sediment.

The total number of cattle in southeastern Michigan was estimated to be 134,800 in 1967 (Table 4-5). This number is expected to increase to about 195,700 by the year 2020. Presently there are about 150 feedlots in southeastern Michigan, each with 100 or more head of cattle.

TABLE 4-5--Present and Projected Numbers of Beef- and Veal-Producing Animals in Southeastern Michigan

Subarea	1967	1980	2000	2020
1	41,400	46,600	67,100	70,400
2	12,000	10,700	10,700	9,300
3	1,600	1,500	1,400	800
4	57,400	68,500	74,300	85,300
5	22,400	24,400	28,200	29,900
TOTAL	134,800	151,700	181,700	195,700

Without waste treatment, the chemicals, bacteria, and other contaminants from about 2.0 million tons of waste from cattle could enter the streams in southeastern Michigan each year. This could increase to about 3.0 million tons by the year 2020 by current projections.

The pollution of streams and ground water from domestic sewage systems is a problem in southeastern Michigan. This problem will increase as population increases. Much of this is due to improperly functioning septic tanks and to soils unsuitable for disposal fields. The problem is particularly severe on the nearly level lake plains of southeastern Michigan. Here, where soils are heavy with high water tables, unsuitable conditions exist for septic systems.

Contamination of ground water in shallow aquifers in glacial drift is common. Infiltration from contaminated storm runoff as well as seepage from poorly functioning sewage systems occur. This is associated with contamination of ground water in deeper bedrock aquifers. This runoff contains fecal coliform bacteria, fertilizer and other chemicals, road oil, organic debris, sediment, and other liquid and solid substances.

Monroe County has extensive areas where overlying glacial drift is thin or absent, exposing the underlying cavernous, dolomitic limestone. Extensive pollution of ground water, due to the inflow of polluted surface water, occurs in this cavernous bedrock.

A critical ground water pollution problem exists in northeast Whiteford Township, Monroe County. A 6-square-mile area, largely cropland, is drained by a series of natural sinkholes or caverns. Surface runoff from roads, feedlots, inadequate sewage systems, and cropland is polluting the ground water that is used for domestic purposes. A recent increase in infectious hepatitis has been reported by the Monroe County Health Department

UPSTREAM FLOODING

Whenever runoff volume exceeds channel capacity, overflow into the adjacent flood plain causes flooding with resultant floodwater damages. Although flooding may occur at any time of year, it happens most often during March and April as the result of snowmelt and spring runoff.

Very general studies have been made in the past few years by the Soil Conservation Service for the Federal Insurance Administration of the U.S. Department of Housing and Urban Development. These studies have led to the recognition of a flooding problem in 73 communities. They subsequently became eligible for flood insurance (Table 4-6). In addition there are 33 communities in which a hazard situation has been identified, but these communities have not applied to be included in the program. No estimate of the extent of damages that would occur annually has been made. In most cases totals would be small and the damage areas scattered.

During the Southeastern Michigan Water Resources Study the U.S. Department of Agriculture confined its efforts to flooding in the upstream areas and the Corps of Engineers studied the main stems and principal tributaries (Figure 4-5). The Corps of Engineers will report on downstream flood studies in a separate report at a later date.

Surveys were made of reported agricultural flood problem areas. Although over 200,000 acres of flood plain were considered, few of the areas were determined to have damages that would support structural solutions through project action.

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

HURON CO.

SANILAC CO.

BLACK RIVER BASIN

1

LAPEER CO.

ST. CLAIR CO.

JOINS UPPER RIGHT

PORT HURON

MICHIGAN
UNITED STATES
CANADA
ONTARIO

INGHAM CO.

LIVINGSTON CO.

OAKLAND CO.

HURON RIVER BASIN

5

ANN ARBOR

WASHTENAW CO.

JACKSON CO.

HILLSDALE CO.

LENAWEE CO.

ADRIAN

RIVER RAISIN BASIN

4

FULTON CO.

MICHIGAN
OHIO

RIVER ROUGE BASIN

3

DETROIT

WAYNE CO.

YPSILANTI

JOINS LOWER LEFT

LAPEER CO.

BELLE RIVER BASIN

ST CLAIR CO.

PINE RIVER BASIN

1

PORT HURON

ST. CLAIR RIVER

MACOMB CO.

2

CLINTON RIVER BASIN

PONTIAC

MT. CLEMENS

LAKE ST CLAIR

DETROIT RIVER

MONROE

MONROE CO.

LAKE ERIE

MICHIGAN
UNITED STATES
CANADA
ONTARIO

N

LEGEND

STATE LINE
COUNTY LINE
STREAM, LARGE
STREAM, SMALL
LAKE
HIGHWAY, INTERSTATE
HIGHWAY, U S
HIGHWAY, STATE
OTHER HIGHWAYS
CITY BOUNDARY
BASIN BOUNDARY
STUDY AREA BOUNDARY
SUBAREA BOUNDARY

UPSTREAM FLOOD PROBLEM AREAS

1. ELK CREEK
2. MILL CREEK
3. SMITH CREEK
4. UPPER BELLE RIVER
5. BELLE RIVER
6. MARSH DRAIN
7. SWARTOUT CREEK
8. BEAUBIEN CREEK
9. SWAN CREEK
10. MARSAC CREEK
11. NORTH BRANCH CLINTON RIVER
12. TUPPER BROOK
13. SOUTH ORE CREEK
14. FLEMING CREEK
15. SWIFT DRAIN
16. TRAVER CREEK
17. HONEY CREEK
18. MILL CREEK
19. SWAN CREEK
20. STONY CREEK
21. SANDY CREEK
22. SALINE RIVER
23. PLUM CREEK
24. OTTER CREEK
25. BAY CREEK
26. INDIAN CREEK AND SALTER DRAIN
27. HALFWAY CREEK AND SPRING BROOK
28. SOUTH BRANCH RAISIN RIVER
29. WOLF CREEK
30. TONQUISH CREEK
31. RIVER RAISIN

DOWNSTREAM AREAS TO BE EVALUATED BY CORPS OF ENGINEERS

MICHIGAN
WISCONSIN
ILLINOIS
INDIANA
OHIO
LAKE MICHIGAN
LAKE HURON

SCALE 1:615,150
SCALE 1 0 1 2 3 4 5 6 7 8 9 MILES

SOURCE
SCS DRAWING S.R. 31,919 AND INFORMATION FROM FIELD TECHNICIANS

POLYCONIC PROJECTION

USDA-SCS-LINCOLN NEBR. 1974

FIGURE 4-5

SOUTHEASTERN MICHIGAN WATER RESOURCES STUDY

MICHIGAN

UPSTREAM AREAS WITH SIGNIFICANT EXISTING OR POTENTIAL FLOODING PROBLEMS

U.S. DEPARTMENT OF AGRICULTURE
Economic Research Service, Forest Service
and Soil Conservation Service

S.R. 32,244

TABLE 4-6--Status of HUD Insurance Program, September 30, 1974

County	Areas Eligible In Program	Hazard Identified-Not in Program
Lenawee	0	1
Lapeer	0	1
Livingston	1	0
Macomb	10	0
Monroe	8	12
Oakland	18	4
Sanilac	0	0
St. Clair	13	3
Washtenaw	1	4
Wayne	22	8
TOTALS	73	33

No further analysis was made on the reaches that could not justify project solutions. Watershed areas that could justify further analysis have large contiguous areas of flooding in intensive agriculture and can obtain protection with a limited degree of channel improvement. None of the areas could obtain protection by flood retention structures. Major reasons the non-feasible reaches were dropped from the study include the following:

1. Land use changed away from intensive agriculture.

2. The area to benefit included only scattered cropland parcels.

3. A solution could be enacted by an individual landowner without project action.

4. Protective measures were already installed and giving adequate reduction.

5. Structural measures needed to protect the area are too expensive and extensive for benefit to be derived.

6. Some problems were caused by lack of adequate gradient to Lake St. Clair or Lake Erie, for which no economical solution is available.

Thirty-one upstream areas with significant existing or potential flooding problems are identified in this report. Existing urban development is subject to flooding in eight areas. Agricultural flooding and associated drainage problems occur in five areas. Nineteen areas have minor flood problems at present, but are under urban development pressure. The Saline River has both urban and agricultural problem reaches.

Present urban development along 77 miles of stream in eight reaches affects nearly 12,000 acres of land (Table 4-7). Estimated present damages are over $700,000 annually. Continued uncontrolled growth in the flood plain would increase the annual damage to nearly $2.5 million by the year 2000. Each of the areas is within or adjacent to a major city that is presently expanding.

Flooding of prime agricultural land is a significant problem on 19,000 acres in the study area. Each of the five areas also has inadequate drainage and four of the areas are discussed in the following section on wet cropland as needing project action. Flooding reduces crop yields by scouring away roots, drowning plants, and washing away grain or fruit. Spring flooding delays planting or prevents seeds from germinating. Floods in the fall can delay harvest and reduce quality and quantity of yields. Agricultural losses are estimated at $1.3 million annually (Table 4-8). These areas are located in the north and southwest portions of the area.

Urban development is expected to take place in the flood plains along 106 miles of streams because of the proximity of existing urban development and topographic site conditions. These areas seem attractive for residential use despite the risk of flooding.

The 19 areas identified in Table 4-9 include an estimated 9,100 acres of potential development land. Present use of the land includes some housing and several roads, but future growth would increase potential flood damage from two to five times present amounts. Future uncontrolled growth in the flood plain would result in over $2.6 million annual damage.

Another area of flooding in the Study Area occurs along the portion of the western shore of Lake Erie from the Michigan-Ohio boundary northward 22 miles to the community of Estral Beach. This area is most vulnerable to flooding at high lake stages, and in most cases the flooding extends inland for less than a mile. This lake flooding affects areas along the lower reaches of Stony Creek, Sandy Creek, Plum Creek, and Bay Creek.

TABLE 4-7--Urban Flooding Problem Areas

Stream	County	Location		Length	Area	Average Annual Damage	
		Reach	Urban Areas	Miles	Acres	Present	2000
Middle Br. & N Branch, Clinton River (11)[1]	Macomb	Clinton R. to 25 Mile Road	Mt. Clemens, Waldenburg, Meade	25	7,500	$181,750	$990,000
Swift Drain (15)	Washtenaw	Washtenaw Rd. to Railroad	Ann Arbor	3	120	24,300	49,950
Traver Creek (16)	Washtenaw	Huron River to M-14	Ann Arbor	3	111	19,855	63,130
Saline River (22)	Washtenaw Monroe	River Raisin to Saline	Saline, Milan	13	2,004	218,000	495,175
Plum Creek (23)	Monroe	L. Erie to Raisinville Rd.	Monroe City South Monroe	5	364	75,200	149,500
Halfway Creek & Brooks Creek (27)	Monroe	Stateline to M-151	Lambertville	10	702	20,000	302,650
Wolf Creek (29)	Lenawee	River Raisin to Nr.Pfister Hwy.	Adrian	4	317	46,950	127,550
Tonquish Creek (30)	Wayne	Middle Rouge R. to N. Territorial Road	Westland Plymouth	14	613	132,750	321,375
TOTAL				77	11,731	$718,805	$2,499,330

[1]Map location number.

TABLE 4-8--Agricultural Flooding Problem Areas

Stream Number	Stream	County	Average Annual Damage (Dollars)	Cropland Flooded (Acres)
1	Elk Creek	Sanilac	1,000,000	12,000
4	Upper Belle R.	Lapeer & St. Clair	210,000	1,300
12	Tupper Brook	Macomb	2,000	400
22	Saline River	Washtenaw	16,000	3,200
24	Otter Creek	Monroe	40,000	2,200
TOTAL			1,268,000	19,100

The elevation of Lake Erie varies annually as well as monthly, depending on the amount and distribution of precipitation. These variations occur slowly. Sudden changes can occur due to strong winds or significant changes in barometric pressure. The level of Lake Erie can be raised rather dramatically by wind action, the height of the rise depending on wind duration, velocity, and direction. The most critical wind direction for the western shore of Lake Erie is from the east-northeast. The lake level has risen as much as 6 feet within 8 hours. In addition to the flooding damage, direct wave damage occurs. During some storms, waves more than 20 feet high crash onto shore.

Shoreline damages are almost entirely nonagricultural. The Corps of Engineers estimated the damage from one of the largest recent storms to be $1.2 million. About 75 percent of this damage was classified as residential with most of the remainder being commercial and municipal. To a lesser degree and under slightly different physical circumstances, similar problems occur on portions of the Detroit River and Lake St. Clair. The Corps of Engineers evaluates this problem and cooperates with local governments and groups toward reduction of damages.

TABLE 4-9--Potential Urban Flooding Problem Areas

Stream and Map Location No.	County	Location		Length	Area	Average Annual Damage	
		Reach	Urban Areas	Miles	Acres	Present	2000
Mill Creek (2)	St. Clair	Norman Road to Arenot Rd.	Yale	5	509	$ 41,950	#137,150
Smith Creek (3)	St. Clair	Pine River to Mayer Road	Smiths Creek	3	174	18,150	38,650
Belle River (5)	St. Clair Macomb	Meskill Road to Miller Road	Memphis Riley Center	14	1,440	86,600	240,750
Marsh Drain (6)	St. Clair	St. Clair River to Broadbridge Rd.	Algonac	2	125	20,075	47,450
Swartout Creek (7)	St. Clair	St. Clair Rd. to Stone Road	Pearl Beach	3	152	19,675	55,875
Beaubien Creek (8)	St. Clair	Lake St. Clair to Markel Road	Starrville	5	327	40,860	99,575
Swan Creek (9)	St. Clair	Lake St. Clair to Marine City Hwy.	Fairhaven	7	469	48,400	145,675
Marsac Creek (10)	St. Clair	Lake St. Clair to Marine City Hwy.	New Baltimore	3	138	39,300	71,600
South Ore Creek (13)	Livingston	Ore Lake to Woodland Lake	Brighton	5	364	78,900	152,250
Fleming (14)	Washtenaw	Huron River to Joy Road	Ann Arbor Dixboro	7	554	62,200	257,475
Honey Creek(17)	Washtenaw	Huron River to I-94	Ann Arbor	3	111	21,690	47,275
Mill Creek (18)	Washtenaw	Dam at Dexter to Marshall Rd.	Dexter	3	243	25,800	69,975
Swan Creek (19)	Monroe	Highway U.S.24 to Carleton West Rd.	Carleton	7	628	74,000	229,600
Stony Creek(20)	Monroe	Lake Erie to Rawsonville Rd.	Stony Creek, Woodland Beach, Scofield	15	2,247	61,550	341,100
Sandy Creek(21)	Monroe	Lake Erie to Highway U.S.24	Monroe	6	437	84,275	240,500
Bay Creek	Monroe	Lake Erie to Cemetery Road	Erie	4	226	42,700	137,450
Indian Creek and Salter Dr.(26)	Monroe	Maybee Road to Secor Road	Lambertville	6	301	41,355	175,375
South Branch Raisin River (28)	Lenawee	Codman Rd. to Sand Creek Hwy.	Adrian	4	323	34,555	125,550
River Raisin(31)	Washtenaw	Allen Rd. to Sharon Valley Rd.	Manchester	4	325	41,860	89,175
				106	9,034	$883,895	$2,632,475

WET CROPLAND

There are two general types of wet cropland problems, surface and subsurface. Most of the wet cropland problems in southeastern Michigan are caused by inadequate subsurface drainage where subsoil permeability is low. The primary cause of surface wetness problems are uneven land surfaces with pockets or ridges that prevent or retard natural runoff. In many cases surface and subsurface water combine to cause flooding and impaired drainage.

In general, wet cropland results in a lower quality crop (or no crop at all), reduced yields, higher production costs, and inefficient use of land, labor, and capital. Spring plantings are delayed by the wet soil conditions, crop selection is then limited to those with shorter growing seasons, and recommended crop rotations cannot be followed where this condition exists.

Approximately 887,200 acres of wet cropland and pastureland are in the Study Area. Not all of this is feasible to drain for a number of reasons. Approximately 285,000 acres are not now in production, but awaiting a change in use such as to urban development. Another 35,000 acres is pastureland that is not feasible to drain from an economic standpoint. Active cropland that is of marginal quality or under pressure from urban development and thus is not feasible to drain, totals 97,200 acres.

Thus the real problem of drainage exists on 470,000 acres, more than half the wet cropland in the region. It is feasible to drain this land and regional benefits would be realized. Approximately 28,410 acres of this wet cropland are in large enough blocks with a variety of ownership to require possible project action. These same acres also suffer flooding problems which further complicates the situation. Elk Creek and Upper Black River Watershed in Lapeer and Sanilac Counties have about 21,750 acres of cropland with impaired drainage and flooding problems. Project action would be required to solve flooding problems on 1,370 acres in Upper Belle River Watershed in Lapeer and St. Clair Counties, 2,190 acres in Otter Creek Watershed in Monroe County, and 3,100 acres in Tupper Brook Watershed in Macomb County.

The remaining 441,590 acres are in smaller areas and the application of artificial drainage would be done by individual landowners or occasionally as a small group project by two or three owners.

Seventy percent of the wet cropland that is feasible to drain is classed as prime agricultural land (Figure 4-6). Field crop production includes cash crops such as corn, oats, and wheat. Specialty crop production includes sugar beets, field beans, and vegetables.

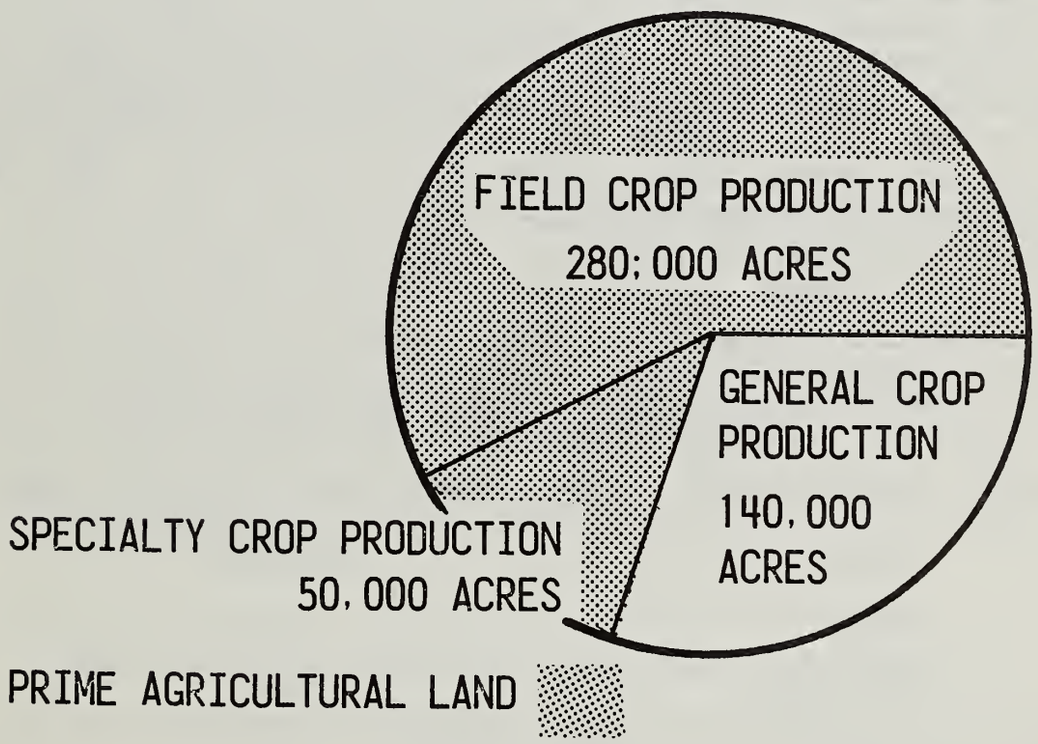


Figure 4-6 Type of Cropland Feasible to Drain

SOIL EROSION AND SEDIMENT

Soil erosion generates a twofold problem--depletion of the land resource and damage to water resources by the resulting sedimentation. Sheet, wind, streambank, and roadside erosion occur in rural areas and are significant problems. Erosion on construction sites is the major problem in urbanizing areas.

Soil erosion is considered a problem on about 32 percent of the land in the region. This varies from 11 percent of the land in Sanilac County to 67 percent of the land in Lenawee County (Table 4-10). Soil erosion is a problem when erosion rates exceed tolerable limits established by soil scientists. Most soils in southeast Michigan have tolerable erosion rates of 3 or 4 tons per acre per year with a range of 2 to 5 tons. Erosion rates greater than the tolerable limit lead to permanent loss of soil productivity.

TABLE 4-10--Percent of Land Where Sheet Erosion Rates Exceed Tolerable Limits

County	Percent
Sanilac	11
Lapeer	65
St. Clair	25
Livingston	36
Oakland	16
Macomb	11
Washtenaw	57
Wayne	14
Lenawee	67
Monroe	35
Total Study Area	32

Tolerable erosion rates are not the only measure of problems related to sedimentation. Erosion rates that are less than the tolerable rate often are significant in creating sedimentation problems, particularly relating to water quality. Values shown in Table 4-8 could be much higher in reference to water quality. No quantitative data is available to express critical erosion rates as they apply to water quality and other sedimentation problems.

The average erosion rate on the agricultural and other open land in the Study Area is about 2.6 tons per acre per year (T/A/Y). By counties, average erosion rates vary from 1.3 T/A/Y in Wayne County to 5.4 T/A/Y in Lapeer County (Table 4-11). In all cases the low rate was found to be essentially zero. By subbasin, the highly urbanized lower Clinton Subbasin has an average erosion rate of only 0.5 T/A/Y, while the rural Upper Raisin and Mill Creek Watersheds have rates of 4.8 T/A/Y (Figure 4-7).

Average sheet erosion rates shown in Table 4-11 are based upon an analysis of more than 900 sample plots selected randomly throughout the Study Area (excluding Detroit and part of its immediate suburban area). The erosion rates on individual plots ranged from less than 1 ton to nearly 24 tons per acre per year. The variation in sheet erosion rates is due primarily to different conditions of slope, cover, and soil type. The higher rates reflect the influence of intensely cultivated land or poor cover conditions and steeper slopes. Lower erosion rates reflect less intense cultivation, established cover, or flatter slopes.

TABLE 4-11--Average and Maximum Sheet Erosion Rates

County	Average Rate Tons/Acre/Year	Maximum Rate Tons/Acre/Year
Sanilac	2.0	4.7
St. Clair	2.1	11.0
Lapeer	5.4	13.1
Oakland	1.5	19.6
Macomb	1.4	18.0
Livingston	3.1	14.5
Washtenaw	4.3	23.8
Wayne	1.3	10.1
Monroe	2.6	7.6
Lenawee	4.2	11.8
Study Area	2.6[1]	23.8

[1]Weighted Average

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

SOURCE
SCS DRAWING NUMBER 5,R-31,919 AND
INFORMATION FROM FIELD TECHNICIANS

USDA-SCS-LINCOLN, NEBR. 1974

FIGURE 4-7
SOUTHEASTERN MICHIGAN WATER RESOURCES STUDY
MICHIGAN

EROSION RATE MAP

U.S. DEPARTMENT OF AGRICULTURE
Economic Research Service, Forest Service
and Soil Conservation Service

9-25-73
5,N-32,457

Estimates of current and projected amounts of sheet erosion on agricultural and other open land are shown in Table 4-12. The decrease of erosion in the future reflects the effect of projected land use changes and the assumed continuation of the current conservation land treatment program.

Urbanization of the land surrounding cities has been at a rapid rate in recent decades. Stripping the land of its vegetative cover and other site preparation exposes land to rapid rates of erosion. Projection of urbanization in southeastern Michigan during the next 50 years indicates annual erosion on the urbanizing land will exceed 1,200,000 tons (Table 4-12). This erosion creates problems at the construction site, on adjacent land, and in the streams receiving runoff from the sites.

TABLE 4-12--Present and Projected Annual Sheet Erosion on Agricultural and Other Open Land

Time Period	Subarea 1	2	3	4	5	Study Area
	1,000 Tons/Year					
1970-1980	1,900	468	175	3,532	1,479	7,553
1980-2000	1,857	450	167	3,480	1,451	7,406
2000-2020	1,813	433	159	3,429	1,425	7,259

The figures in Table 4-13 reflect the condition where an insignificant amount of urban erosion control practices are used. Maximum effort to minimize erosion from construction sites could reduce these erosion rates by 75 or 80 percent. In practice, however, even a well managed program for erosion control may only reduce these rates by 40 or 50 percent.

TABLE 4-13--Present and Projected Annual Soil Erosion From Land Under Development

Time Period	Subarea 1	2	3	4	5	Study Area
	1,000 Tons/Year					
1968-1970	-	-	-	-	-	1111.3
1970-1980	165.6	353.3	346.4	201.5	169.7	1236.5
1980-2000	132.8	175.6	83.1	508.9	284.6	1185.0
2000-2020	154.6	172.6	82.8	511.6	294.3	1206.0

EROSION ON A SUBDIVISION CONSTRUCTION SITE

In 1972 the State of Michigan passed a soil erosion and sediment control act (Act 347) to help alleviate this situation. This Act provides a means by which effective erosion control programs can be accomplished. Problems associated with conducting these programs will involve technical, administrative, and enforcement factors.

A study made of land undergoing urban transition in the summer of 1968 showed that nearly 16,000 acres of land were under development at that time (Table 4-14). This amounted to about 2.1 percent of the land in 33 urbanizing townships surrounding Detroit.

TABLE 4-14--Soil Erosion on Land Under Development, June-August 1968

County	Number of Townships Sampled	Total Acres Under Construction	Percent of County Under Construction	Total Tons Per Year	Average T/A/Y
Macomb	5	1,981	1.72	80,813	42
Oakland	14	6,967	2.16	519,041	75
Washtenaw	4	1,815	1.97	152,147	84
Wayne	10	5,184	2.25	359,251	69
TOTALS	33	15,947	2.10	1,111,252	69

In the 1968 study construction site erosion rates were found to be many times greater than erosion rates on other land throughout the Study Area. The average construction site erosion rate was determined to be 69 T/A/Y. The rate varied from 42 T/A/Y in Macomb County to 84 T/A/Y in Washtenaw County. The variation in erosion rates was due to differences in topography and soil textures in the four counties. This average erosion rate of 69 T/A/Y is about 26 times the average rate of 2.6 T/A/Y on agricultural and other open land in southeastern Michigan (Table 4-9).

The potential for maximum erosion exists when agricultural land is under cultivation for rowcrops and when land under urban development lies stripped of cover. Figure 4-8 delineates areas in southeastern Michigan with different potentials for erosion. These potential differences are based upon the variations in soils and relief characteristics. The nearly level lake plains generally have the least potential for erosion. The steep morainal and rolling outwash areas have the greatest potential. Potential erosion rates vary from 5 tons per acre per year on the lake plains to more than 125 tons per acre per year on rolling land undergoing urban development.

The problem of wind erosion is generally confined to the flat cultivated land on the lake plain portion of the Study Area. Wind erosion is the single biggest erosion problem in Monroe County. Severe problem areas are delineated on the Erosion Potential Map, Figure 4-8. The wind erosion problems are increasing in the area due to fall plowing and lack of windbreaks.

WIND EROSION DEPLETES FERTILE TOPSOIL

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

HURON CO.

SANILAC CO.

BLACK RIVER BASIN

LAPEER CO.

ST. CLAIR CO.

JOINS UPPER RIGHT

MICHIGAN
UNITED STATES
CANADA
ONTARIO

INGHAM CO.

LIVINGSTON CO.

OAKLAND CO.

HURON RIVER BASIN

WASHTENAW CO.

JACKSON CO.

HILLSDALE CO.

LENAWEE CO.

RIVER RAISIN BASIN

FULTON CO.

MICHIGAN
OHIO

RIVER ROUGE BASIN

WAYNE CO.

MONROE CO.

LAKE ERIE

JOINS LOWER LEFT

LAPEER CO.

BELLE RIVER BASIN

ST. CLAIR CO.

PINE RIVER BASIN

MACOMB CO.

CLINTON RIVER BASIN

LAKE ST. CLAIR

MICHIGAN
UNITED STATES
CANADA
ONTARIO

N

LEGEND

STATE LINE
COUNTY LINE
BASIN BOUNDARY
STUDY AREA BOUNDARY
SUBAREA BOUNDARY

POTENTIAL EROSION RATES
FOR BARE SOIL CONDITIONS FOR

SOIL RESOURCE GROUP	AGRICULTURAL LAND	LAND UNDER DEVELOPMENT
15, 20, & 21	(POORLY DRAINED AND ALLUVIAL SOILS NOT RATED)	
16, 17, 18, & 19	LOW - 5 TO 10 TONS/ACRE/YEAR	HIGH - 25 TO 74 TONS/ACRE/YEAR
3, 4, 7, & 12	MODERATE - 10 TO 20 TONS/ACRE/YEAR	VERY HIGH - 75 TO 125 TONS/ACRE/YEAR
9 & 10	HIGH -> 25 TONS/ACRE/YEAR	SEVERE -> 125 TONS/ACRE/YEAR

WIND EROSION PROBLEM AREAS

MICHIGAN
WISCONSIN
ILLINOIS
INDIANA
OHIO
LAKE MICHIGAN
LAKE HURON

SCALE 1/615,150
SCALE I 0 1 2 3 4 5 6 7 8 9 MILES

SOURCE
SCS DRAWING NUMBER 5,R-31,919 AND
INFORMATION FROM FIELD TECHNICIANS

POLYCONIC PROJECTION

FIGURE 4-8

SOUTHEASTERN MICHIGAN WATER RESOURCES STUDY

MICHIGAN

EROSION POTENTIAL MAP

U.S. DEPARTMENT OF AGRICULTURE
Economic Research Service, Forest Service
and Soil Conservation Service

4-26-78
5,R-32,174

Streambank erosion is considered severe along approximately 280 miles of stream in the Study Area (Table 4-15). Over half of these streambanks are in Lenawee County. Streambank erosion is an extremely complex physical process involving the channel dimensions and shape, channel bottom and bank materials, streamflow, gradient, and other factors. Generally the banks are most vulnerable during periods of high floodwater flows. Local bank failures and removal of cover are also caused by surface runoff and stock watering along the streams. Streambank erosion is unique in that all of the eroded material enters the stream.

TABLE 4-15--Miles of Streambank Erosion

County	Miles of Streambank Erosion		
	Slight	Moderate	Severe
Sanilac	12	5	20
St. Clair	100	80	10
Lapeer	--	--	1
Macomb	80	25	20
Oakland	24	10	4
Livingston	2	1	--
Wayne	--	--	--
Washtenaw	5	10	3
Monroe	10	25	75
Lenawee	307	167	147
TOTAL	540	323	280

Annual damages from streambank erosion are not available by county, however, average annual damages have been estimated for the entire Study Area. These damages include an annual damage of $37,400 in farmland loss, $6,900 in sedimentation damage, and $16,200 in damages to roads, bridges, and other facilities.

STREAMBANK EROSION ON A TYPICAL SOUTH-
EASTERN MICHIGAN STREAM

Roadside erosion is a problem in the Study Area. About 110 miles of roadbanks have severe erosion problems (Table 4-16). Most of these are found in Lenawee, Sanilac, and Livingston Counties.

ROADSIDE EROSION

TABLE 4-16--Miles of Roadbank Erosion

County	Miles of Roadbank Erosion		
	Slight	Moderate	Severe
Lenawee	375	225	25
Washtenaw	500	200	10
Livingston	1	9	21
Lapeer	15	33	4
Monroe	900	400	--
Macomb	100	40	10
Oakland	21	15	10
Sanilac	4	34	25
St. Clair	100	15	5
TOTAL	2,016	971	110

Sediment deposition causes a variety of problems in the Study Area. Sediment deposited in the streams, lakes, and coastal waters destroys fish habitat. Sediment reduces channel and reservoir capacity, eventually necessitating costly cleanouts. Sediment that reaches the harbor areas must be removed by dredging and relocated in disposal areas.

An assessment of the average annual amount of sediment deposited in manmade lakes and reservoirs in southeastern Michigan shows a total of approximately 880,000 tons in the Study Area. Average annual gross erosion from agricultural land, other open land, and developing urban areas is about 10 times this amount. The other 8 million tons of eroded soil is deposited locally, below eroding slopes, in drainage ditches, on marsh land, in natural lakes, and in stream channels. Some of the soil is carried to Lakes St. Clair and Erie and deposited as sediment in harbors or in open water areas.

Reservoir sediment data provides a quantitative measurement of the sediment produced throughout the Study Area. The average rate of sediment accumulation varies from 119 acre-feet each year at Kent Lake in Livingston County, to 0.2 acre-feet annually at the Manchester Mill Dam in Washtenaw County (Figure 4-4 and Table 4-17).

TABLE 4-17--Reservoir Sediment Surveys

Reservoir	Age[1] (Years)	Surface Area (Acres)	Uncontrolled Drainage Area (Sq.Mi.)	Original Capacity (Ac.Ft.)	Present Capacity (Ac.Ft.)	Avg. Sed. Thickness (Ft.)	Avg. Water Depth (Ft.)	Avg. Sed. Dry Unit Wt. (lbs/cu.ft.)	Percent Storage Loss (%)	Average Annual Sediment Accum. (Ac.Ft.)
Saline	31	30.2	76.6	240.1	129.6	3.7	4.3	44	46	3.56
Bridgeway	41	12.6	7.5	76.7	47.9	2.3	6.1	46	37.5	0.7
Franklin Mill	136	14.6	14.1	97.8	13.1	5.8	0.9	50	87	0.61
Tecumseh (Evans)	100+	25.6	26.3	227.8	94.7	5.2	3.7	59	58.4	1.33
Sharon Hollow	42	47.8	37	258.1	143.9	2.4	3.0	30	44.2	2.7
Norvell	100±	89.7	60	717.6	502.3	2.4	5.6	23	30	2.15
Brooklyn	21	45	32.3	249.3	186.3	1.4	4.1	43	25	3.0
Manchester (Power)	23	39.2	6.4	288.9	259.5	0.8	6.6	32	10.2	1.28
Manchester (Mill)	63	2.7	50	21.3	10.9	3.9	4.0	38	49	0.17
Kent Lake	18	1,200	152	12,204	10,068	1.6	7.8	59	17.5	118.7
Stony Creek (North)	6.3	114	38.3	996	883	1.0	7.6	--	11.3	17.95
Stony Creek (South)	6.3	452	68.2	3,929	3,661	0.7	8.3	78	6.8	42.54
Flat Rock	44	174.3	31.6	941.2	639.7	1.7	3.7	27	32	6.85
Belleville	40	1,260	20.3	19,945	17,980	1.6	14.3	69	9.8	49.2
Ford Lake	36	969	86	17,926	16,085	1.9	16.6	81	10.3	51.1
Barton Pond	54	300	183	3,150	2,601	1.8	8.6	39	17.4	10.17
Iron Mill	100±	125	16.2	1,551	1,159	3.1	9.3	11	25	3.93
Tecumseh (Red Mill)	100±	114.8	25.9	677	336	3.0	2.9	42	50	3.41
H. N. Fry (Onsted)	7	15.4	12.5	121.3	116	0.4	7.5	--	4.4	0.76
Newburgh Lake	36	95.4	62.3	667.8	562.9	1.1	5.9	56	16	2.91
Adrian	28	86	74.2	1,000	851	1.7	9.9	75	15	5.32
Waterford Pond	100±	29	54	173	101	2.5	3.5	39	41	0.72
Phoenix Pond	100±	27.5	56.8	225	170	2.0	6.2	42	25	0.53
Average	54	229	45.2	2,856	2,461	2.3	6.5	47	29	14.33

[1]Reservoirs surveyed during period of April 1969 to October 1969.

TONS OF SOIL DEPOSITED IN MARSHLAND IN AN URBANIZING WATERSHED

The reservoir sediments contain a mixture of silt, clay, fine sand, and organic material. Some sediment densities are low, reflecting a high organic content. Organic material is one of the major components of reservoir sediment in the Study Area.

Sediment accumulates in lakes and reservoirs, reducing their capacity and thus their use for water supply, fishing, and recreation. Sediment deposited in streams and rivers limits various uses including navigation and thus hinders the economy. Navigation facilities in southeastern Michigan require periodic dredging for maintenance. The annual amount of dredged material removed from localities that keep records is shown in Table 4-18. The dredged material has other constituents in addition to eroded mineral soil. Waste products of industrial facilities, urban runoff, and sewerage are included in the dredgings. Soil is, however, the largest single component.

TABLE 4-18--Annual Amounts of Dredging from Selected Locations

Dredging Area	Annual Dredging		
	Cubic Yards	Tons	Annual Cost[1] (Dollars)
St. Clair River	200,000	135,000	
Lake St. Clair Channels	200,000	135,000	
Black River	3,000	2,000	
Belle River	1,000	670	
Clinton River	20,000	13,500	
River Rouge	300,000	202,000	376,000
Detroit River	800,000	540,000	272,000
Monroe Harbor	176,000	119,000	77,000
TOTAL	1,700,000	1,147,170	

[1]U.S. Army Corps of Engineers, Buffalo District, 1969, Dredging and Water Quality Problems in the Great Lakes.

CHAPTER V

Alternatives and Solutions

CHAPTER V

ALTERNATIVES CONSIDERED

Sound long-range planning at local through Federal levels is essential to solving the water and land resources problems in southeastern Michigan. This chapter examines some of the solutions that should be considered by planners. Most of the solutions involve managing the resources to prevent future problems.

LAND USE

Agriculture

The decreasing supply of idle or surplus cropland is described in Chapter IV as a potential problem that could become critical by 2020 if the region is going to continue to produce its share of the national demand for food, feed, and fiber. It could be critical for other reasons. Agricultural use of the idle cropland will result in additional soil loss and sediment, since much of this land is highly erosive. The cultivation or development of the region's supply of idle cropland will also mean the loss of some of the best habitat for ring-necked pheasants, cottontail rabbits, quail, and ground-nesting birds.

To minimize this situation, long-range land use plans should include management of agricultural land, including that which is idle. Four agricultural land management options that should be considered by planners are compared here on the basis of (1) the amount of idle cropland remaining after the projected demand for food, feed, and fiber has been met, (2) the cost of crop production, (3) the amount of cropland that would be drained, and (4) the potential increase in crop production above the projected demand levels.

Each option and its effects are discussed below and should be examined individually. However, the wisest land use plan would probably not adopt a single option but a combination of options.

Option A: No More Drainage

In this option, action would be taken to stop all new agricultural drainage as shown in Table 5-1. Only maintenance work on existing drainage systems would be carried out. Projected crop yields would be based on current drainage conditions. Idle cropland would be used as needed to satisfy the projected demands for production.

Effects: With this option, the region could produce its share of the national demand for food, feed, and fiber in 1980 and have 639,000 acres of cropland in reserve supply (Table 5-2).

In the event of a food crisis, this idle cropland reserve could be used to increase food production by 60 percent above the projected production level (Table 5-3). By 2020, with a continued expansion in population and urban land requirements, the region's supply of idle cropland could be reduced to about 20,000 acres. With Option A, this means that the region will be producing nearly all the food that it can in less than 50 years. To do this, marginal land and highly erosive land must be brought back into production. Crop production costs are estimated at $49.8 million in 1980 and $62.8 million in 2020.

Option B: Efficient Drainage Only

This option would allow agricultural drainage that efficiently reduces the cost of meeting the projected production demands.

Effects: About 104,000 acres of wet cropland would be drained by 1980 and an additional 80,000 acres would be drained by 2020. Production costs and land requirements are less with Option B than with Option A. Annual production costs are estimated to be $48.9 million in 1980 and $60.0 million in 2020. Idle cropland acreage projections are 659,000 acres in 1980 and 91,000 acres in 2020. The difference in efficiency is most

significant in 2020. The full food production capacity of A and B are approximately the same in 1980. In 2020, 5 percent more food could be produced with B. Total drainage installation costs would be $63 million and technical assistance costs would be $3 million.

Option C: Maximum Drainage

Recognizing the irreplaceable nature of prime agricultural cropland, action would be taken to preserve the 518,000 acres so defined for the production of food, feed, and fiber. This prime land would be managed at a high level of efficiency. Agricultural drainage would be fully used.

Effects: With the preservation of the prime cropland from urban encroachment and other development, less land would be needed to obtain projected crop production in the region. In 1980, 845,000 acres would be idle, some 206,000 fewer acres of active cropland than that needed with Option A; and by 2020, 273,000 fewer acres. For most efficient management, approximately 280,000 acres of wet cropland should be drained by 2020. Most of the drainage would be on the prime land. The region's capacity to produce food would be increased approximately 20 percent over Option A in both 1980 and 2020. The cost of production under Option C was not computed, but was expected to be the least of the four options. Drainage installation costs would be $97 million and technical assistance costs, $4.8 million.

Option D: Maximum Erosion Control

Projections indicate that approximately 300,000 acres of cropland will be on highly erosive soils by 1980 and 200,000 acres by 2020. To reduce erosion and sediment, action would be taken to require the use of conservation measures to keep soil losses at an acceptable level. Agricultural drainage would be used to reduce costs or if necessary to satisfy projected food demands.

Effects: This option would reduce the idle cropland reserve by 343,000 acres by 1980. By 2020, the supply of idle cropland would be depleted because all available cropland would not satisfy the projected demand for food. Since the highly erosive land would be removed from the agricultural land base,

TABLE 5-1--Cropland To Be Drained with Agricultural Land Management Options[1]

Sub-Area	1980 Options A	1980 Options B	1980 Options C	1980 Options D	2020 Options A	2020 Options B	2020 Options C	2020 Options D
	1,000 Acres							
1	0	38.0	140.0	38.0	0	53.0	155.0	109.0
2	0	1.6	14.0	1.6	0	1.2	17.0	13.5
3	0	1.1	0.8	1.1	0	0.7	1.0	0.7
4	0	58.0	82.0	72.0	0	128.0	107.0	123.0
5	0	5.0	0.7	4.5	0	1.5	1.0	2.7
TOTAL	0	103.7	237.5	117.2	0	184.4	281.0	248.9

[1]Cumulative addition from 1980 accounting for loss of previously drained land to nonagricultural use.

TABLE 5-2--Idle Cropland with Agricultural Land Management Options

Sub-Area	1980 Options A	B	C	D[1]	2020 Options A	B	C	D[2]
	1000 Acres							
1	213.8	215.0	--	186.5	5.7	49.7	--	0
2	107.4	107.4	--	43.4	1.2	13.8	--	0
3	9.9	9.9	--	9.9	---	--	--	0
4	184.0	201.8	--	55.9	9.3	14.7	--	0
5	123.6	125.4	--	--	4.1	12.7	--	0
TOTAL	638.7	659.5	844.5[3]	295.7	20.3	90.9	292.9[3]	0

[1]The 300,000 acres of highly erosive soils returned to permanent cover is not classified as idle cropland, but as nonagricultural open space.

[2]The 200,000 acres of highly erosive soils returned to permanent cover is not classified as idle cropland, but as nonagricultural open space.

[3]Idle cropland acreages were not determined by subareas with Option C.

the potential capacity to produce food would be reduced. In 1980 the reserve capacity to produce food would be reduced by almost 50 percent. It should be noted that the highly erosive cropland that would be returned to permanent cover would be available for pasture or other open space uses. By 2020, about 248,900 acres of wet cropland would have to be drained to satisfy projected food demands. Total drainage installation costs would be $86 million and technical assistance costs would be $4 million.

TABLE 5-3--Full Production with Agricultural Land Management Options

Agricultural Land Management Option	Projected Production[1]	Full Production[1]	Percent Increase
	million bushels		
1980			
A	71.8	114.6	60
B	71.8	116.0	62
C	71.8	128.4	79
D	71.8	91.6	28
2020			
A	116.0	117.9	2
B	116.0	124.3	7
C	116.0	141.1	22
D	116.0	116.0	0

[1]Food, feed and fiber production shown in equivalent bushels of corn.

Forest

Trees ameliorate many of the problems associated with a harsh urban environment. Trees absorb sounds, collect dust and dissipate odors, enhance aesthetics, maintain the carbon dioxide and oxygen

balance, reduce wind velocities, and moderate air temperatures. In addition certain species of trees serve as sensitive bio-indicators of the dangers of air pollution. Thus, a strong and effective urban forestry program is needed to preserve and manage the forest environment in the urban and urban expanding areas of southeastern Michigan if these benefits are to be realized.

FOREST LANDS, IN THEIR UNDEVELOPED STATE, CAN PROVIDE THE URBAN DWELLER WITH NATURAL SETTING FOR OUTDOOR ACTIVITY.

As envisioned, an urban and community forestry program would have four primary goals:

1. To stop the accelerating deterioration of the natural environment resulting from the loss of trees and related plants.

2. To promote reforestation where needed.

3. To encourage planning that would make the best use of trees and related plants in newly developing urban areas.

4. To disseminate research information that encourages the better use of trees to improve the human environment.

The four primary program goals can be accomplished by a combination of education, training, and technical assistance. Through education and training, urban and community leaders, associations, groups, and landowners would be informed about the

importance of trees and how to make the best use of them for maintaining or improving the environment. The program would:

1. Endeavor to increase public understanding of the need for and purpose of coordinated land use and conservation programs.

2. Increase appreciation and understanding among planning agencies and residential and industrial developers of the importance of providing for trees. Education and demonstrations would be used to show the importance of good planning.

3. Inform urban and community leaders how to develop comprehensive forestry programs and how to make the best use of sources of help.

4. Foster local groups with urban and community forest related interests. Groups would be encouraged and assisted through education media. These groups would include schools at all grade levels; tree protection and recreation associations; nature study, tree identification, and conservation groups; and urban 4-H clubs.

5. Instruct homeowners in the planting, protection, and maintenance of trees and the contribution of trees to landscape values. This could be done through group meetings, demonstrations, and use of mass media.

6. Instruct unskilled labor in planting, protecting, and maintaining trees and other woody plants, thus providing a source of skilled employees for nurserymen, homeowners, and others. This could possibly involve arrangements with manpower development and training programs of the U.S. Department of Labor.

7. Train park employees, municipal tree workers, commercial landscape maintenance operators, and consultants in improved techniques and equipment, in repairing and moving trees, and in dealing with special urban tree problems in connection with insects, diseases, soil erosion, and air and water pollution.

8. Provide assistance to commercial nurserymen as needed in selecting, growing, and handling planting stock for urban forestry purposes.

Technical assistance made available to public and private agencies and to individuals will be in the context of guiding the planting, growing, protecting, and maintaining of trees; and in planning, developing, and managing trees and associated plant communities within the urban environment.

Specific elements of the technical assistance phase of the program are:

1. Planning the use of trees and associated woody plants in community development.

2. Detecting, identifying, and controlling insects, diseases, animals, pollutants, and other agents damaging to trees.

3. Protecting community forests, parks, and other areas of growth from wildfire.

4. Caring for, repairing, and removing trees. Assistance would include advice on methods and techniques, on equipment design and operations, and other information needed to efficiently and economically deal with specific tree care problems.

FOREST LAND MANAGEMENT TECHNICAL ASSISTANCE IS AVAILABLE.

5. Cultural improvement and maintenance of trees and associated plants for enhancement of recreational opportunities, wildlife, and aesthetics in an urban and community forestry setting.

6. Site preparation, planting, and seeding for establishment of trees and associated plants.

7. Assistance to commercial tree nurseries in nursery management, including all phases of producing and distributing planting stock for urban and community forestry purposes.

8. Assistance in urban forestry-related problems involving forest land use. This could include advice concerning soils and the interpretation of soil survey data; control of runoff, erosion, and sedimentation; water management including problems of flooding, drainage, and surface water disposal; small watershed hydrology; and various phases of plant technology as they relate to soil and site conditions.

9. Support for development and application of credit and approved cost-sharing practices under this program.

10. Referrals of requests for planting, tree maintenance, pest control, and other measures to commercial consultants and contractors, where feasible and appropriate.

The recommended program, as outlined above, would not be a new program. It is envisioned as an extension of the current forest management program administered by Michigan Department of Natural Resources.

Urban expansion projections identify the Clinton and Huron River Basins as areas that will be significantly affected by urban sprawl. Based on these projections, the establishment of urban and community forester positions at Ann Arbor and Pontiac would move the program towards attainment of the four goals outlined on page 5-7. These two positions would provide education, training, and technical assistance for dealing with 68,000 acres of forest land projected for urbanization.

Program costs can only be estimated because of the changing costs of "doing business." A realistic estimate involving the two positions is $50,000 per year.

Upon implementation of the program, the personnel of the Department of Natural Resources currently assigned to ongoing cooperative forest management duties in primarily rural areas will be able to devote more of their time to the assigned duties. At present, a substantial amount of their time is devoted to urban forestry assistance.

There are no quick or easy solutions to fire problems in urban areas. However, certain steps can be taken to reduce the problem;

1. Organization--clear assignments of responsibility for protection, and provisions made for the "crossover" of help is needed. The training of formerly rural fire departments in problems associated with suburban wildfire is also a necessity.

2. Fire Prevention and Detection--a good information and education effort through the mass media is needed during critical fire danger periods, usually the spring and late fall.

3. Firebreaks and Fuel Reduction--an effort should be made to encourage suburban developers and homebuilders to use fire retardant material for roofs and to establish zones around each building that are free of flammable debris. Fuel reduction can be accomplished by the periodic, prescribed burning of idle lands and by the planting of less flammable, deciduous tree species in predominantly coniferous areas.

The current intensive program for the gypsy moth, as provided by the Michigan Department of Agriculture in cooperation with the U.S. Department of Agriculture is adequate and should continue.

There is a definite need for tax law revisions. As desirable as it may be to maintain seminatural stands of trees in urban areas, the landowner simply can not afford to pay the ad valorem taxes. This type of taxation could be replaced by a method that recognizes the importance of preserving natural features in the semi-urban environment. Such a revision could be applicable to all wooded tracts regardless of size, and qualification could be based upon the recommendation of a professional forester. In the urban expanding areas, a yield tax based on the amount of timber harvested should not be included. However, in the rural environs, this type of tax will help offset local decreases in revenue and could be included if professional forestry advice is made mandatory prior to harvest.

In areas of the basin where urbanization is not projected (primarily Subarea 1), there is a definite need to promote growth into the sawtimber size classes through selective removals in the overstocked, hardwood poletimber stands. The most effective way to accomplish this is to find new markets for this poletimber material.

AN INTERMEDIATE CUT IN LARGE SIZED STANDS IS OFTEN DESIRABLE TO PROMOTE GROWTH AND ESTABLISHMENT OF A NEW STAND.

Previous markets, such as pulp and fuel wood, have become insignificant and only a very limited market currently exists. The potential for new markets is present and can be developed if certain recommendations are accepted:

(1) Implement an intensified forest products utilization study in the rural basins of the Study Area.

(2) Intensify current information and education programs directed at the private landowners, encouraging them to make better use of the forested acres they own.

(3) Locate available markets, jobbers, and landowners with forest products to sell and provide the means for getting all three together.

The intensified utilization study would involve approximately 1 man-year of time at an estimated cost of $18,000. With this type of study, the forest resource is analyzed for availability (landowner objective), extent, and location. Existing facilities using the raw material are also examined to determine if expansion is feasible and the labor supply is adequate. If new industry is desirable, a specialist would work with economic development agencies and industry in financing, site location, and markets.

As discussed in Chapter III, timber production is projected to remain stable in Subarea 1. Within this subarea, 8,200 acres of commercial forest land need accelerated land treatment to bring them into full production. Land treatment includes the practices of tree planting, timber stand improvement, and grazing reduction. The treatment application cost is estimated to be $239,000. Approximately 10 man-years of technical assistance would be required at a cost of $200,000.

Urban

The urban forestry program outlined in the forest land use section and the preservation of recreation land discussed in the recreation section would alleviate the urban problems described in Chapter IV.

Recreation

The Bureau of Outdoor Recreation will prepare a recreation report at a later date that will present specific solutions to meet the recreation needs of southeastern Michigan. This appendix considers ways to protect the prime recreation land in the Study Area from other land use developments.

One recreation problem in the region is competition for the land resource, mainly from urban development. Prime recreation land is being used for other purposes which often preclude future use for recreation. Critical problems exist in Subareas 2 and 5.

The solving of recreation land use problems is well under way in southeastern Michigan, on both the regional and the county levels. Regional and county land use plans document the interest in preserving land for open space recreation. Much of the information in this report can be used to support recreation land use planning.

Various alternatives are available to preserve recreational lands. These include outright purchase, dedication of a percentage of land from all new urban developments, zoning, and multiple use of land. With over 200,000 acres of prime recreational land in the southeastern Michigan area, it is important to seek methods of preserving this land.

Outright purchase is probably the most widely practiced alternative today and needs little discussion. Any governmental unit, or private or public group can purchase, operate, and maintain recreational land. The limiting factor is, of course, funds for making these purchases.

Another alternative is the dedication of a certain percentage of the land in new developments for recreational uses. Builders are permitted to build homes and other buildings on smaller lots as a trade-off for dedicating the recreational acreage. This does not alter the overall population density over the entire development, but merely concentrates it on part of the tract. This recreational land must be maintained by the municipality since citizen group maintenance tends to deteriorate after the first few years.

Zoning represents another viable alternative to help preserve land for recreational uses. This could be tied in with a flood plain management program as suggested in the section on upstream flooding in Chapter IV. Flood hazard areas (flood plain areas that are inundated by the 100-year storm) should not be developed and can be zoned for noncritical uses including recreation.

Multiple use of lands gives another opportunity to preserve recreational land. Land being preserved for other uses such as forest and wildlife preserves also can be used for compatible recreational purposes.

Fish and Wildlife

The U.S. Fish and Wildlife Service will prepare a fish and wildlife report at a later date that will present specific solutions to meet needs of southeastern Michigan. This appendix presents ways that land can be used to preserve and enhance the fish and wildlife resources in the Study Area.

The major fish and wildlife habitat problems in southeastern Michigan are the loss of idle cropland, clean farming, and urban development. Fish habitat deteriorates as it is degraded by poor water quality in many upstream areas.

Potential alternate solutions are numerous and include such things as preservation of wildlife land, protection and enhancement of streambanks, minimum tillage, wise planning and use of urban land, management and utilization of transportation and utility corridors, reclamation of mined areas, protection and preservation of wetlands, and creation of County Scenic Rivers.

Wildlife land can be preserved by many of the same alternatives offered in the previous section on recreation. Not all apply, but for the most part they do offer viable alternatives.

There is a need to protect and enhance streambank vegetation. Counties or townships could adopt ordinances to restrict land and vegetation disturbances along legal drains and streams. A buffer zone extending 20 feet outward from the top of the bank on legal drains and a

50-foot buffer zone on streams would preserve and enhance this valuable habitat. Width should vary depending on stream size and flood plain width. Removing live woody vegetation in this zone would be prohibited except by special permit from the county or township. When channel cleanouts are planned, assistance from a biologist or forester could insure that no unnecessary clearing is undertaken. Farmers could enhance fish and wildlife habitat by voluntarily providing 10-foot buffer zones along open ditches in their fields. Minimum disturbance of vegetation would help reduce sediment deposition in ditches, reduce nutrient-rich runoff, improve water quality, provide wildlife food and cover, and improve aesthetic quality.

More good land management is needed to reduce erosion and sedimentation. Sediment is responsible for degrading fish habitat by filling in deep pools, covering spawning grounds, and limiting aquatic food organism production. Keeping the sediment on the land is the answer to this problem.

Wildlife habitat is severely damaged from clean farming. Creating and managing fence rows and windbreaks and maximizing the availability of crop residues through minimum tillage will help maintain and enhance the present wildlife community.

Wildlife land is being changed to urban use at an accelerated rate, particularly idle cropland and forest land. Residential land, both rural and urban, can play a significant role in maintaining a supply of wildlife habitat.

A landscape planned to provide wildlife habitat in urban areas can also have aesthetic value. This kind of landscape can be created by intermingling a variety of plant species of different sizes and shapes. Endless choices of combinations to consider in designing a natural landscape exist through the use of hardwood and coniferous trees and shrubs, vines, grasses, flowers, and even weeds. In small yards, it may be necessary to limit planting to single specimens of different plants. With much larger areas, hedges, tree and shrub clumps, food plots, and other massed plantings can be used.

HEDGEROW PROVIDES WILDLIFE HABITAT

Living screens or hedges of trees and shrubs, planted along property lines, driveways, and existing fences, provide food and cover for songbirds and other species of wildlife. Conifers, autumn olive, dogwood, bush honeysuckle, spirea, forsythia, or a combination of these make good living screens. The importance of these hedges for wildife depends upon their location and management. Diversity of wildlife species using these hedges tends to be greater in rural residential or farming areas rather than in urban residential areas. Pheasants, bobwhite quail, tree squirrels, chipmunks, raccoon, opossum, and songbirds might be found in rural areas, while cottontail rabbits, tree squirrels, and chipmunks would be more common to the urban hedges.

Winter cover can be provided by the use of cedar, pine, or spruce windbreaks which will provide warm, safe shelter for many species of wildlife. A food plot or feeder nearby will help to keep songbirds throughout the winter months.

Plots of corn, sunflowers, millets, and grain sorghum are attractive to such "seedeaters" as cardinals, sparrows, goldfinches, and juncos. If properly located they are also of value to pheasants, quail, squirrels, and cottontail rabbits. Plots can be small, perhaps consisting of several short rows, or larger if space is available.

When planting food and cover to attract wildlife, factors to consider include the soil, slope, drainage, exposure, and climate. In general, trees and shrubs that are attractive to wildlife grow satisfactorily on well-drained, fairly fertile, and somewhat loamy soils. An optimum soil has a loose, loamy upper layer 18 inches or more in depth and is neutral to slightly acid. However, many species of trees and shrubs are tolerant to soils with less than optimum conditions.

County road departments should preserve and enhance wildlife habitat in the rights-of-way of gravel county roads. It is estimated that 45,000 acres of land is available along county roads for wildlife habitat management (Table 5-4). Necessary maintenance such as mowing and brush clearing should be kept to a minimum and undertaken after the nesting season for birds and small mammals, preferably after July 15.

Landowners should request that large trees be saved from cutting in the rights-of-way. Landowners should allow brush and trees that are cut to be put in piles for wildlife cover on idle land along the rights-of-way. There are a few drawbacks to consider. Preserving trees and brush in rights-of-way of roads would cause an increase in snow accumulation on roads in some areas, an increase in animals on the roadway, and an increase in fire hazard. Large trees in the rights-of-way can be safety hazards when a vehicle accidently leaves the road. Steepness of some slopes precludes the growth of some types of vegetation and therefore may not offer an improved quality habitat.

Wildlife habitat could also be increased along railroad and public utility rights-of-way. This could be done by limiting maintenance to minimum cutting and mowing that would take place only after the nesting season was completed. Brush could be piled on rights-of-way for wildlife cover without detremental effects to transportation or public utilities. However, this unmanaged condition could pose a wildland fire hazard if precautionary measures such as spark arrestors are not employed. It is estimated that 6,200 acres of land is available for wildlife habitat management in railroad rights-of-way (Table 5-5).

TABLE 5-4--County Road Right-of-Way Land Suitable for Wildlife Habitat Management

County	Right-of-Way Land Acres
Lapeer	3,600
Lenawee	4,600
Livingston	3,500
Macomb	3,300
Monroe	3,900
Oakland	7,600
St. Clair	4,600
Sanilac	5,500
Washtenaw	4,300
Wayne	4,100
TOTAL	45,000

RAILROAD RIGHTS-OF-WAY CAN PROVIDE ABUNDANT WILDLIFE HABITAT.

Many of the surface mines in the Study Area represent potential for development as fish and wildlife habitats, should mining activities cease. There are about 107 active surface mines in the Study Area as identified by the U.S. Bureau of Mines (Table 5-6). Most of these are sand and gravel pits although several quarries also operate. The Mineral Resources Appendix contains more information on these surface mines.

BORROW PIT WITH POTENTIAL FOR FISH AND WILDLIFE HABITAT DEVELOPMENT

TABLE 5-5--Railroad Right-of-Way Land Suitable for Wildlife Habitat Management

County	Right-of-Way Land Acres
Lapeer	400
Lenawee	820
Livingston	400
Macomb	330
Monroe	930
Oakland	760
St. Clair	460
Sanilac	350
Washtenaw	470
Wayne	1,280
TOTAL	6,200

Wetlands are one of the most valuable kinds of wildlife habitat. Because wetland acreages are expected to decrease as a result of urban expansion, wetland preservation is an immediate concern. County commissions should work with the Soil Conservation Districts and the Michigan Department of Natural Resources to develop wetland protection ordinances that would prohibit the draining and filling of all wetlands. County planning commissions should be responsible for obtaining a county wetland inventory. Tax relief, purchasing, and long-term leasing could be used to preserve wetlands. Existing wetlands would thus continue to produce their distinct species of wildlife and recharge ground water supplies.

WETLAND WILDLIFE HABITAT

The Black River in Sanilac County and portions of the Clinton River in Macomb County may qualify as a County Scenic Rivers under the Natural River Act of 1970. A study should be made by the Michigan

TABLE 5-6--Active Surface Mines

County	Sand Gravel Pits	Clay Pits	Peat Mines	Limestone Quarry	Sandstone Quarry
Lapeer	--	--	4	--	--
Lenawee	10	1	--	--	--
Livingston	5	--	--	--	--
Macomb	11	--	--	--	--
Monroe	--	1	2	5	1
Oakland	27	--	2	--	--
Sanilac	4	--	3	--	--
St. Clair	6	1	1	--	--
Washtenaw	11	--	--	--	--
Wayne	9	2	--	1	--

Department of Natural Resources to determine if they qualify. Under this act the fish and wildlife habitat in the flood plain would be protected against unrestricted development.

Portions of the Pott's Creek Watershed, part of the Elk Creek Watershed in Buel Township, Sanilac County, have severe drainage and flooding problems on existing agricultural land. This area has potential for development as migratory waterfowl feeding grounds and other wetland bird and mammal habitat. A study by the Michigan Department of Natural Resources is needed to evaluate the potential of acquiring portions of this area for incorporation into a State game area.

WATER POLLUTION

The Corps of Engineers, the State of Michigan, and the Environmental Protection Agency will prepare a water quality appendix for the Southeastern Michigan Water Resources Study. This will provide a more detailed discussion of the subject.

Sediment is one of the major pollutants in surface water in the Study Area. Control of sediment at the source is the most effective approach to the problem. Various ways to reduce sediment by controlling erosion are discussed in the Soil Erosion and Sediment section of this chapter.

Ground water pollution is also a problem in southeastern Michigan, especially in the lake plain areas. Pollution from private septic tanks can be controlled at the county level by sanitary ordinances. Pollution from surface water inflow can be reduced if surface outlets exist or can be created.

Polluted surface water inflow has created a critical ground water pollution problem in northeast Whiteford Township in Monroe County. Preliminary field surveys and studies indicate that it would be physically feasible to construct a surface drainage outlet into Ten Mile Creek.

The drainage system would include excavating open channels from a 6-square-mile regional depression, diverting the surface water from existing sinkholes, sealing the sinkholes, and pumping the surface water from the individual sinkhole areas to the open channels.

With the increasing number of beef cattle and the trend toward centralization, the problem of surface and ground water pollution from livestock waste becomes more critical in southeastern Michigan.

Livestock waste disposal systems have been installed by many farmers in the region who practice confined livestock feeding. These systems perform four basic functions:

1. Divert surface water entering the feedlot.

2. Collect polluted water and manure that originates in the feedlot.

3. Store polluted water and manure for the period of the year when the land is frozen, snow covered, or water saturated.

4. Dispose of wastes on the land when soil conditions are suitable for infiltration, at a rate that will minimize leaching of nitrates.

Local conservation districts can provide technical assistance to help design and install animal waste disposal systems which should help reduce surface water pollution.

UPSTREAM FLOODING

Both existing or potential flood water problems are alleviated by flood plain management. The Water Resources Council proposes three basic categories for flood plain management, encompassing both structural and non-structural measures:

1. Those that modify the susceptibility to flooding, including land use regulation, open space acquisition, building codes, zoning, developmental policies, floodproofing, or flood forecasting.

2. Those that modify the characteristics of flooding, including floodwater-retarding reservoirs, dikes, levees, or flood walls, channel alterations and diversions, and land treatment measures.

3. Those that modify the consequences of flooding, including disseminating flood hazard information, flood insurance, tax adjustments, flood fighting, and recovery and flood relief assistance.

Often the best solution is a combination of some of the above.

When the flood plain has been developed, generally the most desirable solution is one or more of the measures under category 2 if economically feasible. Otherwise it is necessary to resort to one or more of the measures under categories 1 and 3 such as zoning out additional development, floodproofing, and flood insurance.

In flood plain areas that are not developed but appear to be attractive settings for development, one of the measures under category 1 would probably be appropriate. Zoning could prevent development that would be subject to floodwater damage.

Use of flood plains for purposes that would lessen the impact of flooding should be encouraged. An example of this is shown in the photograph of the flood plain used for an attractive roadside park.

If flood plains in the Study Area are more intensively used in the future, 16 areas with over 106 miles of streams will have potential flooding problems. Urban development has not taken place in most of these areas, and flood plain management techniques, which modify the susceptibility of an area to flooding, are the most logical to implement. Most alternatives in this category depend upon the delineation of the 100-year flood plain. Land use regulations, open space acquisition, zoning, flood insurance, and developmental policies are some alternatives (Table 5-7). Establishment of flood plain zoning and other regulations could reduce future expected damages of $2.6 million to present levels of $0.9 million.

FLOODWATER WILL ONLY CAUSE MINOR DAMAGE TO THIS PARK -

Flooding is now a problem in eight areas with 77 miles of streams because some urban development has already occurred (Table 5-7). Flood plain management in these areas is more complex. Here a combination of measures is needed. Alternative solutions include structural and non-structural measures. Delineation of the 100-year flood plain is essential for selecting the specific solutions.

One area, around the North Branch of the Clinton River, can obtain flood damage reduction by a combination of three floodwater retarding dams, channel work, and diversion. Flood plain zoning and flood insurance should also be instituted to control new growth and provide insurance to present property holders. This program would cost about $16 million and provide a reduction of present damages from nearly $200,000 annually to about $25,000. Projected future damage would be reduced from $990,000 to about $50,000 average annual damage.

The other seven urban areas presently suffering flood damage can not be feasibly protected by structural measures. These areas need combinations of flood plain zoning or purchase, building codes, flood-proofing, and flood insurance. These measures would reduce present losses by approximately 50 percent and future damages of $1.5 million by about 75 percent.

Four upstream areas have existing agricultural flood problems which lend themselves to economical solutions by structural methods that will modify the characteristics of flooding. These areas are Elk Creek, Upper Belle River, Tupper Brook, and Otter Creek. Each of these will require land treatment and channel work to relieve the flooding and accompanying soil wetness problems. Other structural measures such as dams or dikes are not feasible for these areas. However, individual farm drainage pump outlets are a feasible alternative to channel work on Otter Creek. Channel work would reduce flooding and improve soil drainage on 28,400 acres of cropland and provide $1.2 million of benefits.

WET CROPLAND

Individual landowners in the Study Area can correct most of their wet agricultural land problems by independent or small group action, with the assistance of the Soil Conservation District. In four watersheds, however, project action is necessary to solve the problem due to a common drainage outlet problem.

TABLE 5-7--Feasible Solutions to Upstream Flooding Problems

Flood Problem Area	County	Feasible Alternatives[1]
Present Urban Damage Areas		
N. Branch Clinton Rv. (11)[2]	Macomb	FR, DI, CW, FZ, FI
Swift Drain (15)	Washtenaw	FZ, BC, FI
Traver Creek (16)	Washtenaw	FZ, BC, FP, FI
Saline River (22)	Washtenaw & Monroe	FZ, FP, FI
Plum Creek (23)	Monroe	FZ, FP, FI
Halfway Creek & Brooks Creek (27)	Monroe	FZ, FP, FI
Wolf Creek (29)	Lenawee	FZ, FP, FI
Tonquish Creek (30)	Wayne	FZ, BC, FI
Agricultural Problem Areas		
Elk Creek (1)	Sanilac & Lapeer	CW, FZ
Upper Belle Rv. (4)	Lapeer & St. Clair	CW, FZ
Tupper Brook (12)	Macomb	CW, FZ
Saline River (22)	Washtenaw	NS
Otter Creek (24)	Monroe	CW, FZ, P
Potential Urban Flood Problem Areas		
Mill Creek (2)	St. Clair	FZ, FI
Smiths Creek (3)	St. Clair	FZ, FI
Belle River (5)	St. Clair & Macomb	FZ, FP, FI
Marsh Drain (6)	St. Clair	FZ, FI
Swartout Creek (7)	St. Clair	FZ, FI
Beaubein Creek (8)	St. Clair	FZ, FI
Swan Creek (9)	St. Clair	FZ, FI
Marsac Creek (10)	St. Clair	FZ, FI
South Ore Creek (13)	Livingston	FZ, FI
Fleming Creek (14)	Washtenaw	FZ, FI
Honey Creek (17)	Washtenaw	FZ, BC, FP, FI
Mill Creek (18)	Washtenaw	FZ, BC, FI
Swan Creek (19)	Monroe	FZ, FI
Stony Creek (20)	Monroe	FZ, FI
Sandy Creek (21)	Monroe	FZ, FI
Bay Creek (25)	Monroe	FZ, FI
Indian Creek & Salter Drain (26)	Monroe	FZ, FI
S. Branch Raisin R.(28)	Lenawee	FZ, FI
River Raisin (31)	Washtenaw	FZ, FI

[1]FR--Floodwater Retarding, DI--Dikes or levees, CW--Channel work, FZ--Flood plain zoning or purchase, BC--Building Codes, FP--Flood proofing, FI--Flood insurance, P--Pumping, NS--No feasible solution.

[2]Numbers refer to Figure 4-5.

ELK CREEK WATERSHED--LAPEER AND SANILAC COUNTIES

The Elk Creek Watershed has about 21,750 acres of cropland with impaired drainage, most of which is designated as prime agricultural land. Also included in the soil wetness problem area are 500 acres of pasture, 1,570 acres of forest land, and approximately 20 acres of Type 4 Wetland, as defined by the U.S. Fish and Wildlife Service.

Project action would involve 86 miles of channel work, with an average annual cost of $599,700. Total average annual benefits are estimated to be $914,100.

UPPER BELLE RIVER WATERSHED--LAPEER AND ST. CLAIR COUNTIES

Approximately 1,370 acres of prime organic cropland in the Upper Belle River Watershed in Lapeer County have impaired drainage. In addition to the active cropland, the problem area includes 180 acres of idle cropland, 185 acres of forest land, and approximately 15 acres of Type 4 Wetland.

Project action would widen and deepen 7.5 miles of channel at an average annual cost of $38,950. Total average annual agricultural benefits would be $210,000.

OTTER CREEK WATERSHED--MONROE COUNTY

Otter Creek Watershed has 2,190 acres of prime cropland with a wetness problem. The problem area also includes 30 acres of pasture, 50 acres of idle cropland, and 300 acres of forest land. Project action would provide an outlet by deepening and widening 5 miles of channel. Average annual project cost would be $29,500 and the average annual benefit, $43,200.

Construction of individual farm drainage pump outlets is a feasible alternative solution. The existing channel has adequate capacity for this type of system. Average annual cost including operation and maintenance is estimated to be $14,440. Average annual benefits would still be $43,200.

TUPPER BROOK WATERSHED--MACOMB COUNTY

Tupper Brook Watershed, a subwatershed of the North Branch Clinton River Watershed, has approximately 3,100 acres of prime cropland with impaired drainage. Also in the problem area are 250 acres of pasture-land and 450 acres of forest land.

The Soil Conservation Service and the Forest Service have assisted local people in preparing a watershed work plan to reduce future flood-water damages and provide an adequate agricultural drainage outlet. The proposed structural measure consists of approximately 14 miles of channel work at an average annual cost of $35,500. Average annual benefits would be $49,100.

SOIL EROSION AND SEDIMENT

Stabilizing the sediment source by proper land management and erosion control measures is the most direct and usually the most satis-factory approach in dealing with sediment problems. Where the sediment is derived from sheet and rill erosion, proper land use management as well as land treatment measures effectively reduce sediment yields.

Control of excessive sediment arising from construction activities, including both new highways and industrial and urban developments, could include one or a combination of the following basic approaches: (1) reducing the period of time during which the ground is exposed to erosion, and (2) preventing the sediment from making its way to stream courses in the area. The control of streambank and streambed erosion usually requires emphasis on structural measures.

Benefits accrue from the control of sediment pollution in many ways. They include: (1) reduction in the cost of removing sediment from channels, harbors, and reservoirs, (2) reduction in the cost of treating water for municipal and industrial uses, (3) reductions in maintenance costs associated with power production, water distribution systems, and highways, (4) reductions in damage to wildlife habitat, (5) prevention of damage to flood plains, and (6) enhancement of recreational facilities.

Conservation land treatment would reduce the annual soil loss from the active cropland in the region by approximately 930,000 tons. This reduction can be realized by applying conservation measures or management to approximately 540,000 acres of rowcrops (Table 5-8). The remaining 600,000 acres of active cropland are either adequately treated or are in small grain or grass, all of which are subject to minor soil loss. On an acre basis, the average annual soil loss could be reduced from 4.1 to 2.4 tons per year.

TABLE 5-8--Potential Soil Loss Reduction with Land Treatment of Land in Rowcrops

Subareas	Rowcrop Land Needing Treatment (Acres)	Soil Loss--Tons/Year		
		Present Conditions	With Treatment	Reduction
1	116,000	364,000	237,000	127,000
2	31,000	130,000	74,000	56,000
3	11,000	30,000	22,000	8,000
4	327,000	1,304,000	803,000	501,000
5	55,000	402,000	164,000	238,000
TOTAL	540,000	2,230,000	1,300,000	930,000

Many conservation practices can be applied to cropland and other rural areas to effectively control erosion. A variety of land treatment measures can be used to provide adequate protection to the soil. For example, applying a cover crop reduces erosion from 50 to 80 percent. A combination of contouring and using a cover crop reduces the soil loss from 75 to 90 percent. Changing cultivated fields from rowcrops to small grain may reduce the soil loss from sheet erosion 60 to 75 percent, depending on cover conditions, soil, and seasonal distribution of rainfall. Rotation of crops to include meadow in the cropping sequence may reduce the on-site soil loss approximately 75 percent.

Changing tillage practices can reduce runoff and soil loss. Plowing and planting without any intervening tillage can reduce soil loss as much as 40 percent over conventional tillage. Planting without plowing, leaving all plant residue on the soil surface, and controlling weeds by herbicide application instead of cultivating can reduce soil loss by 90 percent. Adequate soil drainage and good timing of operations are necessary to secure satisfactory crop yields with those methods.

Much of the cropland in the western part of the Study Area is moderately to highly erosive (Figure 4-7). Under present conditions, approximately 50 percent of the soil loss shown in Table 5-8 comes from 120,000 acres of rowcrop land in this area. The average erosion rate on this land is 8.9 tons per acre per year.

A WINTER COVER CROP OF RYE AND CORNSTALKS LEFT ON THE GROUND PROVIDE SOIL PROTECTION

One solution to the erosion problems in this area is to protect the land with a permanent cover of grass or other suitable vegetation rather than cropping it. A well established grass cover can almost eliminate all soil loss. The impact of keeping or taking this land out of crop production is analyzed in agricultural land management Option D in the beginning of this chapter.

An alternative solution is to protect the cropland with conservation measures, such as contouring, contour strip cropping, terraces, and grassed waterways. With land treatment the erosion rate could be reduced to 3.3 tons per acre per year and the total soil loss to 680,000 tons per year. This is approximately 75 percent of the total soil loss reduction shown in Table 5-7.

The major thrust of the land treatment effort should be in Subareas 4 and 5, where approximately 102,000 acres of rowcrops are grown on moderately to highly erosive land. To accelerate the ongoing land treatment program in this area, approximately 80,000 additional acres should be treated in the next 10 years. The cost of applying this land treatment would be $1.3 million. Approximately 17 man-years of technical assistance, costing $350,000, would be required.

From field observations it is estimated that erosion control measures and techniques applied to urban construction can reduce the average erosion rate from 69 tons per acre per year to 10 tons or less. With over 15,000 acres of land expected to be converted to urban use each year, this becomes significant. Numerous techniques are used. Basically, these techniques are aimed at: (1) reducing the area and duration of exposure of soils to erosion, (2) covering exposed soils with mulch or vegetation, (3) mechanically reducing the rates of storm runoff, (4) trapping the sediment carried by storm runoff, and (5) planning land-clearing operations to coincide with periods of minimum rainfall.

In applying these principles, various combinations of the following practices have proved effective:

1. Selecting land where drainage patterns, topography and soils are favorable for the intended use.

2. Fitting the development to the site and providing for erosion control in the site development plan.

3. Using areas not well suited for urban development for open space or recreation.

4. Developing large tracts one small unit at a time. On each unit construction can be completed rapidly so that large areas are not left bare and exposed for long periods.

5. Minimizing grading and removing only undesirable trees or vegetation.

6. Controlling runoff and conveying it to storm sewers or other outlets so it will not erode the land or cause offsite damage.

7. Protecting critical areas during construction with mulch or temporary cover crops and with mechanical measures such as diversions and prepared outlets.

8. Constructing sediment basins to detain runoff and trap sediment during construction.

9. Providing for safe offsite disposal of runoff, including the increased runoff resulting from construction.

10. Establishing permanent vegetation and installing erosion control structures as soon as possible.

Reasonably precise information has become available concerning costs to provide erosion control during construction. Records for the past 2 1/2 years from the City of Ann Arbor, Environmental Bureau, Building and Safety Engineering Department, have been examined. Actual costs for erosion control measures may be summarized from these records.

The method used by the City of Ann Arbor to insure compliance with the erosion control ordinance is to require a performance bond as part of obtaining a building permit. The developers plans are examined, his erosion control practices are evaluated, and bond is set to cover actual costs to provide needed erosion control on the development. This assures the City that disturbed land, even if the development project goes into default and is left exposed, will be given adequate erosion control protection.

Fifty-seven permits for new construction requiring land disturbance were issued during the 2 1/2 year period. The City's environmental bureau found it necessary to require bonding on 26, or about 57 percent of these. These bonds ranged from $300 to $150,000 for the individual projects. Area to be protected by erosion control measures ranged from about one acre to 147 acres. Based upon the total of the performance bonds as against the acres of land protected, the average cost of providing erosion control on this urban development was $994 per acre.

On the basis of these cost figures, costs to adequately protect developing land from erosion and sedimentation damages will average about $9,000,000 (15,947 acres x $994 x 57% = $9,035,000) annually in the southeast Michigan area. In addition, technical and inspection services will cost approximately $1 million annually.

Treatment is generally desirable and economical on eroding streambanks if the erosion is threatening a building, a bridge, or some other installation. Treatment is also economical if the erosion rate is high enough to threaten valuable land or if excessively large amounts of sediment are being deposited in a valuable water resource.

Treatment costs vary widely. A cost of $12 to $15 per linear foot of eroding streambank would be average for most areas of southeastern Michigan. It is not known what part of the 280 bank miles of severe streambank erosion, mentioned in Chapter IV, would be economical to treat.

Treatment needs for roadside erosion are also difficult to determine. Based upon recent costs, treatment would be about $750 per acre. If it is assumed that it is economically desirable to treat the 110 miles of severe roadside erosion mentioned in Chapter IV, total treatment costs in southeastern Michigan would run between $500,000 and $1,000,000.

Wind erosion is a very significant problem on the lake plain soils in southeastern Michigan. This is particularly true in Monroe County. A certain amount of wind erosion hazard exists on most cultivated land. However, it becomes particularly pronounced on land that is nearly level, with wide, unprotected fields that are intensely cultivated to rowcrops. Many areas of organic soils and cultivated sandy soils are also subject to intense wind erosion because of the lack of cohesion of the surface soil particles.

Crop rotations that favor the maintenance of good soil tilth are the most effective method of reducing wind erosion. Minimum tillage or no-till would be much better. Strategically placed windbreaks are desirable. No data is available on acres needing wind erosion protection. Much of the cost, however, would be absorbed by the ongoing and accelerated land treatment programs recommended for the area.

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

Washington, D. C. 20250

APR 5 1976

SUBJECT: RB - Southeast Michigan Rivers Basin, Michigan

TO: Richard A. Farley
Director
National Agriculture Library

Attached for your information is a copy of the recently completed report entitled "Southeastern Michigan Water Resources Study, Agriculture Appendix, Michigan." This report was prepared under the authority of Section 6 of the Public Law 83-566, the Watershed Protection and Flood Prevention Act, as amended. The USDA carried out this river basin study in cooperation with the Department of the Army, Corps of Engineers Detroit District.

This report is being furnished in accordance with your request to the River Basins Division, Soil Conservation Service. If you need additional copies or any information pertaining to this report, please let us know.

Robert E. Kohnke

Robert E. Kohnke
Director
River Basins Division

Attachment

CHAPTER VI

Study Recommendations and Methods For Implementation

CHAPTER VI

U S D A RECOMMENDATIONS AND METHODS FOR IMPLEMENTATION

Land and water resource problems in southeastern Michigan demand attention because of the rapidly expanding urban area. This report documents the need for realistic and detailed land use plans, implemented at the regional, county, and township levels. These plans should be for rural and open space lands as well as urban areas.

To help planners solve land and water resource problems, the U.S. Department of Agriculture, Economic Research Service, Forest Service, and Soil Conservation Service, recommend a course of action and who should take the action. Existing Federal, State, and local water and land resource programs can provide technical and financial assistance for most of the recommendations. Complete implementation of the study recommendations may require new land use legislation that would authorize additional technical and financial assistance. Estimated beneficial and adverse effects of applicable recommendations to the accounts of national economic development, environmental quality, regional development, and social well-being are listed in Appendix B.

A document such as this report is only as good as the use made of it. Without a coordinated effort among the various governmental units and others involved, very few recommendations will ever be implemented. Because of this, it is suggested that either the County Board of Supervisors for each county or the Southeastern Michigan Council of Governments (SEMCOG) assume the overall leadership responsibilities to help insure overall coordination of effort.

1. Recommendation: Retain one-half million acres of prime cropland for agricultural use (Figures 2-3 and 2-4). For land use efficiency, the drainage of this land should be considered a part of this recommendation. As a result, tile drains should be installed on approximately 280,000 acres of prime cropland by the year 2020. This recommendation is described as agricultural land management Option C in Chapter V.

   Implementation: To implement this recommendation, a detailed inventory of the agricultural land is required. The inventory should identify land by its productive capability as well as by agricultural use. The modern soil survey report could be a useful tool in classifying land. The U.S. Department of Agriculture and Michigan Department of Agriculture representatives in each county could provide technical assistance in preparing a detailed inventory.

   A plan for the preservation and management of the essential lands (agricultural, forest, mineral and special environments) is being developed by the Office of Land Use, Michigan Department of Natural Resources. As a first step, Federal, State, and local specialists have been brought together to form several land use committees. These committees are helping to develop the criteria local units of government will use to inventory the essential lands. The farm tax relief bill signed by Governor Milliken in May 1974 presently grants landowners tax credit for contracting with the State to protect cropland and forest or open space from urban development for at least 10 years.

   The preservation of prime agricultural land for agricultural production will enable farmers to make long-term investments in agricultural water management. Approximately 3,500 acres of cropland are drained each year in the Study Area. The rate of drainage should be increased by 2,100 acres each

1. Implementation: (continued) year to accomplish the recommended drainage by 2020. The cost of accelerated drainage would be approximately $60 million for installation and $3 mi-lion for 150 man-years of technical assistance. Most of the drainage can be installed by individual farmers. Some areas will require group or project action to obtain an adequate outlet. (See Recommendation 10.)

   The County Board of Commissioners should assume the responsibility for seeing that this recommendation is fully implemented. Farm organizations should add their support.

2. Recommendation: Accelerate the soil survey program in Monroe and Oakland Counties to complete the survey by 1985. Work in Monroe County is 54 percent complete, while work in Oakland County has not begun. To map the remaining 720,000 acres, 24 additional man-years of soil scientists' work will be required, costing approximately $500,000.

   Soil surveys are completed in all other counties in the Study Area. The Soil Conservation Service, in cooperation with the Michigan Agricultural Experiment Station, has published soil surveys for Sanilac, St. Clair, Lapeer, Macomb, and Lenawee Counties. Soil survey reports are scheduled for publication for Livingston County by 1975 and for Washtenaw and Wayne Counties by 1977.

   Soil surveys have been used to guide land use and management decisions on farms and in forests for many years. These same principles of managing soil and water can be applied to urban development problems. The soil survey describes soil limitations for building sites, onsite sewage disposal, road construction, recreational development, and other uses.

2. Implementation: This program could be initiated through the cooperation of the County Commissioners, Soil Conservation Districts, the Soil Conservation Service, and the Michigan Agricultural Experiment Station.

3. Recommendation: Develop an effective urban and community forestry program to provide, protect, restore, and enhance all urban environmental values that are dependent upon the culture of trees. More specifically, the program should have four primary goals:

   (1) Stop the accelerating deterioration of the natural environment resulting from the loss of trees and related plants on the 68,000 acres of forest land projected for urban development.

   (2) Promote the restoration of trees where needed and feasible.

   (3) Encourage planning that will make the best use of trees and related plants.

   (4) Disseminate research information that encourages the better use of trees to improve the human environment.

   To help attain these goals, an urban and community forester position should be created in both Ann Arbor and Pontiac by the Michigan Department of Natural Resources to provide landowners technical assistance in managing the 68,000 acres of forest land projected for urbanization. The estimated cost of the two positions is $50,000 per year.

   Implementation: Assistance to implement the above recommendations is available from the Forest Service and the Michigan Department of Natural Resources through the Cooperative State and Private Forestry Program (Table 6-1). A limited amount of urban forest is currently being managed by the State. To accelerate this program, additional manpower at Ann Arbor and Pontiac is needed.

TABLE 6-1--Cooperative Forest Management Programs
Administered by the U.S. Forest Service

PROGRAM	PURPOSE OF PROGRAM	SPECIFIC FORESTRY ASSISTANCE	WHO TO CONTACT
Cooperative Forest Fire Control, (C-M2)	Protection of forest resources from fire.	Fire protection is provided by the State forestry agency and its cooperators.	Michigan Department of Natural Resources (MDNR)
Cooperative Production & Distribution of Forest Tree Planting Stock. (C-M4)	Produce, purchase and distribute plantings stock or seed for forest, windbarrier or watershed plantings.	State forestry agency provides tree planting stock at moderate prices.	MDNR
Assistance to States for Tree Planting and Reforestation.	Assist the States in undertaking needed programs of tree planting and other forestation work to help assure an adequate future supply of industrial wood.	Cost-sharing on non-federal public lands. Cost-sharing and sometimes contractual services on private land. Technical assistance at no cost to private landowners.	MDNR
Cooperative Forest Management (CFM)	Improve & maintain the productivity of private forest lands, thru technical assistance to landowners and wood processors.	The State forestry agency provides technical assistance to: 1) woodland owners, 2) processors of forest products, and 3) communities in the use and management of trees and shrubs in urban areas.	MDNR
General Forestry Assistance (GFA)	To stimulate interest in better forestry in places and with owners not now reached by other programs.	1. Provides highly specialized technical forest management assistance. 2. Provides forest products processing advice. 3. Provides information & assistance in special programs such as Rural Development.	U.S. Forest Service
Forest Pest Control	Reduce to tolerable levels losses caused by forest insects and diseases, other than blister rust.	1. Leadership in prevention detection evaluation & suppression of forest insect & disease outbreaks. 2. Aid in developing & conducting cooperative control programs. 3. Cost-sharing in cooperative control on State & private lands.	U.S. Forest Service or MDNR
Blister Rust Control	Establish & maintain control of blister rust in all white pine stands where values justify control costs.	1. Leadership & technical direction in developing cooperative programs. 2. Coordination of treatment on all forest lands. 3. Cost-sharing in cooperative control on State and private lands.	U.S. Forest Service and MDNR

3. Implementation: (continued) It is suggested that the Department of Conservation and Resource Development of the United Automobile Workers take the leadership in implementing this recommendation. The objectives of the Department of Conservation and Resource Development can be partially achieved through this recommendation.

4. Recommendation: Promote growth into the sawtimber size classes through selective removals in the overstocked, hardwood poletimber stands. The most effective way to accomplish this end is to find new markets for this poletimber material through a forest products utilization study of the rural areas of the region.

Implementation: To effectively promote the required growth and find new markets, a detailed forest product utilization study is recommended that would determine what is available and where. This study could be accomplished by two possible arrangements.

First, a special study could possibly be arranged with Agricultural Experiment Station through the Department of Forestry, College of Agriculture and Natural Resources, Michigan State University, in East Lansing.

Secondly, a private forestry consultant could be obtained to conduct the recommended study through a contractual arrangement between the Michigan Department of Natural Resources and the U.S. Forest Service.

The Michigan Department of Natural Resources should, through the Area Forester, provide leadership for forest landowners in the Study Area, by initiating action to have the recommendation implemented.

5. Recommendation: Accelerate the land treatment program on 8,200 acres of commercial forest land in Subarea 1 to bring this land into full timber production. The treatment cost is estimated to be $239,000. Approximately 10 man-years of technical assistance cost would be required at a cost of $200,000.

5. Implementation: (continued) Leadership to secure the needed funds should be by the Soil Conservation Districts or other local bodies. Implementation and technical assistance would be by the Michigan Department of Natural Resources in cooperation with the U.S. Forest Service.

6. Recommendation: Maintain and manage streambank vegetation to protect the quality fish streams in the region through the establishment of 50-foot buffer zones along the main-streams and 20-foot zones along the tributary streams and agricultural drains.

   Implementation: Maintenance and management of wildlife buffer zones along main-streams, tributary streams, and drains could be made mandatory by legislation. However, a more desirable method of implementation would be by persuasion. A combination of an information and education program by the Michigan Cooperative Extension Service and a liberal financial incentive program administered by the Agricultural Stabilization and Conservation Service could be used to change landowners' attitudes. Overall leadership and efforts to insure implementation could come from the Michigan United Conservation Clubs through their sponsorship of conferences and educational endeavors.

   Technical assistance in managing this land for wildlife habitat is available from the Soil Conservation Districts, Department of Natural Resources, Cooperative Extension Service, and local fish and game clubs.

7. Recommendation: Manage county road and railroad rights-of-way for wildlife habitat where suitable.

   This recommendation can be implemented through an education program and the preparation of a handbook on the management of rights-of-way for wildlife habitat. This handbook should be prepared as a guide for county road and railroad officials and

7. Implementation: (continued) private landowners. A wildlife biologist, in collaboration with county road and railroad rights-of-way maintenance personnel, would be the best one to prepare this handbook.

Technical assistance is available from the Soil Conservation Districts, the Department of Natural Resources, or the Cooperative Extension Service to help in the preparation of the handbook and to plan the actual management techniques.

Implementation is in line with the overall goals and objectives of the Michigan United Conservation Clubs who could perform an effective and much needed service in this area.

8. Recommendation: Obtain a County Scenic Rivers designation under the Natural River Act of 1970 for the Black River in Sanilac County and portions of the Clinton River in Macomb County.

Implementation: The Michigan National Rivers Act of 1970 authorizes the Michigan Natural Resources Commission to designate recreational, scenic, or wild rivers, after studying their characteristics and determining the purposes which they should serve in the public interest. The statute contains a provision for protecting rivers and their tributaries through zoning the use of land adjacent to the streams, except within the limits of an incorporated municipality.

After designating a river, preparing long-range plans, and holding necessary public hearings, the Commission may declare that the river and tributary lands are to be zoned so as to control and guide their development and provide for their preservation.

The Commission supplies zoning guidelines to counties and townships through which the stream flows. These units of government would then have one year in which to adopt satisfactory zoning ordinances.

8. Implementation: (continued) If a county or township chooses not to enact such an ordinance, or if an adopted ordinance is found to be inadequate or in conflict with the long-range plan and guidelines, the Michigan Natural Resources Commission itself can adopt a zoning "rule" under the provisions of the State Administrative Code. The rule would be of the same nature and serve the same functions as a local ordinance but could not control land use more than 400 feet from the water's edge.

9. Recommendation: Amend or adopt flood plain zoning ordinances, building codes, and similar land use control ordinances in the 27 locations with present and potential urban flooding problems (Table 5-7).

Implementation: To implement the recommended flood plain management, the flood plains should be delineated. Assistance is available through the Soil Conservation Service's Flood Hazard Analyses Program. The total cost of this work would be approximately $366,000. The local cost of administering the land use controls would be approximately $55,000.

Communities should send their requests for assistance to the Michigan Water Resources Commission. Flood plain delineation studies are completed on a priority basis according to the greatest need and highest proposed use for the Study.

Leadership for implementation should come from the County Commissioners in areas where the problems exist. A local community could also take the initiative to start and carry out a particular project.

10. Recommendation: Install structural measures in five upstream flood problem areas: Elk Creek Watershed, Upper Belle River Watershed, North Branch Clinton River Watershed, Tupper Brook Watershed, and Otter Creek Watershed (Figure 4-5).

10. Implementation: (continued)

Project action is required to install structural measures in the first four problem areas. Total installation costs for these four watersheds is $21.5 million, which will result in $2.4 million in average annual benefits. Assistance is available from several sources. Under Public Law 566, the Federal government can assist local communities with their watershed problems. In addition the Michigan Drain Code provides for the organization of county or intercounty drainage districts or water management districts to solve watershed problems through governmental group action.

According to the provisions of Public Law 566, the Soil Conservation Service can provide information to determine appropriate and feasible measures that might be installed to solve flooding problems. The Forest Service can provide technical assistance on woodland management to improve the hydrologic characteristics of the watershed. The Agricultural Stabilization and Conservation Service may allocate additional monies to the watershed area to assist with cost-sharing land treatment measures. This type of assistance is an inducement for getting the desired practices installed on the watershed at a faster rate. The Farmers Home Administration can give watershed loans to local communities to help finance their share of P.L. 566 watershed projects. The Cooperative Extension Service provides education and information program leadership.

A community can initiate action to obtain assistance under Public Law 566 by contacting their local Soil Conservation District and other governing bodies.

Technical assistance is available from the Soil Conservation Service to design the individual farm drainage outlets recommended for Otter Creek Watershed.

11. Recommendation: Make a more detailed study of the ground water pollution problem in northeast Whiteford Township, Monroe County. Preliminary surveys indicate that a surface drainage outlet would be physically feasible. However, more topographic and geologic information is needed to develop a solution to the problem.

    Implementation: The recommended study of the ground water pollution problem in northeast Whiteford Township, Monroe County, could be performed under the Michigan Drain Code through a drainage district. The Drain Code provides that when necessary for public health drains may be petitioned by townships, villages, and other local government units with taxation powers or by the county board of health.

    Because this is also a problem of inadequate drainage, Public Law 566, discussed in the implementation of Recommendation 10, would apply here as well. Leadership could come from the Monroe County Department of Health to carry out the recommended solution.

12. Recommendation: Leadership and implementation of the recommended changes in the conservation land treatment program should be by the Soil Conservation Districts with the Assistance of the Soil Conservation Service. Approximately 17 man-years of technical assistance, costing $350,000, would be required. The cost of applying the land treatment would be $1.3 million.

    Implementation: The Cooperative Extension Service should be requested to conduct an education and information program to encourage landowners to install structural conservation land treatment practices. Additional financial assistance should be requested from the Agricultural Stabilization and Conservation Service to accelerate the land treatment program in the specified areas. Soil Conservation Service county and regional personnel should consider the recommendations in developing their land treatment technical assistance program goals.

13. Recommendation: Support the Soil Erosion and Sediment Control Act of 1972 to reduce erosion on construction sites. With over 15,000 acres of land expected to be converted to urban use each year, erosion could be reduced by up to 900,000 tons annually.

Implementation: Under this Act a permit is required for development requiring an earth change that disturbs one or more acres of land or that disturbs any land located within 500 feet of a lake or stream.

An extensive public education and information program is needed to bring about the recommended enforcement of the Soil Erosion and Sediment Control Act of 1972 by each county. The Cooperative Extension Service could provide leadership for this program. Many environmental action groups such as the League of Women Voters, local chapters of the Sierra Club, and Michigan United Conservation Clubs should be requested to help disseminate information.

Appendices

APPENDIX A

SOIL CHARACTERISTICS TERMINOLOGY

Land use capability is described by class and subclass. Capability Classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I: Soils have few limitations that restrict their use.

Class II: Soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III: Soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV: Soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V: Soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife.

Class VI: Soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.

Class VII: Soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.

Class VIII: Soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, water supply, or aesthetic purposes.

The above capability classes are further divided into subclasses that show the principal kinds of problems involved. The subclasses are: erosion, indicated by e, such as IIIe; wetness, indicated by w, such as Vw; soil limitations (shallowness or droughtiness), indicated by s, such as IVs; and climatic limitations, indicated by c, such as IIc.

The natural internal drainage condition of the soil refers to the frequency and duration of periods when the soil is free of saturation. The five conditions used in Table 2-1 are described as follows:

Very Poorly Drained--Water is removed from the soil so slowly that the water table remains at or on the surface nearly all the time.

Poorly Drained--Water is removed so slowly that the soil remains wet for long periods.

Somewhat Poorly Drained--Soils are wet for significant periods but not all the time. The water table is within 12 to 24 inches of the surface during parts of the year.

Moderately Well Drained--Water is removed from the soil somewhat slowly, so that the soil is wet for a small but significant part of the time.

Well Drained--Water is removed from the soil readily but not rapidly.

The permeability of the soil is its capacity for transmitting water or air. The permeability of a soil may be limited by the presence of one nearly impermeable layer of soil even though the others are permeable. Rates of permeability are expressed in inches per hour. The terms used to describe the permeability in Table 2-1 refer to the following rates:

Permeability Description	Inches Per Hour
Very Slow	Less than 0.06
Slow	0.06 - 0.20
Moderately Slow	0.20 - 0.63
Moderate	0.63 - 2.00
Moderately Rapid	2.00 - 6.30
Rapid	6.30 - 20.00
Very Rapid	More than 20.00

The depth of the seasonal high water table is based on the natural drainage of the soil and refers to the shallowest depth to which the water table rises in early spring. In all soils, particularly on slopes and on uplands, the depth to the water table is generally greater in late spring, summer, and fall than the depth indicated in Table 2-1. The general relationship of water table depth to drainage is as follows:

Depth to Water Table	Drainage
At surface	Very poorly drained
0-1'	Poorly drained
1-2'	Somewhat poorly drained
2-3'	Moderately well drained
3'+	Well drained

APPENDIX B

SYSTEM OF ACCOUNTS

The system of accounts displays the beneficial and adverse effects of selected U.S. Department of Agriculture recommendations on the components of the national economic development, environmental quality, regional development, and social well-being accounts. The components of each account are listed below.

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Beneficial Effects:

A. The value to users of increased outputs of goods and services.

Adverse Effects:

A. The value of resources required for a plan.

ENVIRONMENTAL QUALITY ACCOUNT

Beneficial and Adverse Effects:

A. Areas of natural beauty.
B. Quality considerations of water, land, and air resources.
C. Biological resources and selected ecosystems.
D. Irreversible or irretrievable commitments.

REGIONAL DEVELOPMENT ACCOUNT

Beneficial Effects:

INCOME
A. The value of increased output of goods and services to users residing in the region.

EMPLOYMENT

A. Number and types of jobs.
B. Population distribution.
C. Regional economic base and stability.

Adverse Effects:

A. The value of resources contributed from within the region to achieve the outputs.
B. Loss of assistance payments from sources outside the region to otherwise unemployed or under-employed resources.

SOCIAL WELL-BEING ACCOUNT

Beneficial and Adverse Effects:

A. Real income distribution.

Income Class ($)	Percent Adjusted Gross Income
I. Less than 3,000	5
II. 3,000 to 10,000	33
III. More than 10,000	67

B. Life, health, and safety.
C. Recreational opportunities.

RECOMMENDATION 1--Retain one-half million acres of prime cropland for agricultural use.
For land use efficiency drain 280,000 acres of prime cropland by the year 2020.

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measures of Effects (Average Annual)[1]
Beneficial Effects:	
A. The value to users of increased outputs of goods and services.	
1. Efficiency gains in reduced cost of crop production.	$2,870,000
Adverse Effects:	
A. The value of resources required for a plan.	
1. Annual Installation Cost of Drainage.	2,110,000
2. Technical Assistance Cost.	99,000
3. OM&R of tile drains and outlets.	65,000
Net Beneficial Effects:	$ 737,000

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measures of Effects
Beneficial and Adverse Effects:	
B. Quality considerations of water, land and air resources.	1. Change 273,000 acres of cropland wildlife habitat to habitat associated with grassland, recreation development and urban development. 2. Reduce wetland acreage in close proximity to 280,000 acres of prime cropland to be drained.

[1]50 years @ 5 7/8 percent.

REGIONAL DEVELOPMENT ACCOUNT

Components	Measures of Effects (Average Annual)[1]	
	Region	Rest of Nation
Beneficial Effects:		
A. The value of resources contributed from within the region to achieve the outputs.		
1. Efficiency gains from reduced cost of crop production.	$ 2,870,000	$ -1,330,000
2. Increased units of production and improved quality.	16,200,000	-16,200,000
3. Additional wages and salaries accruing to the region from implementation of the plan.	600,000	-600,000
Adverse Effects:		
A. The value of resources contributed from within the region to achieve the outputs.		
1. Installation cost of drainage measures.	2,110,000	--
2. Technical assistance cost.	--	99,000
3. OM&R of tile drains and outlets.	65,000	--
Net Beneficial Effects:	$17,495,000	$-18,229,000

SOCIAL WELL-BEING ACCOUNT

Components	Measures of Effects
Beneficial and Adverse Effects:	
	1. Could free 206,000 acres by 1980 and 273,000 acres by 2020 for recreational and environmental uses, thereby enhancing quality of life.

RECOMMENDATION 3--Develop an effective urban and community forestry program to provide, protect, restore and enhance all urban environmental values that are dependent upon the culture of trees.

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measures of Effects (Average Annual)[1]
Beneficial Effects:	
Not Determined.	--
Adverse Effects:	
A. The value of resources required for a plan.	
1. Technical assistance cost.	$50,000
Net Beneficial Effects:	Not Determined

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measures of Effects
B. Quality considerations of water, land, and air resources.	1. (trees) Improve air quality by cooling summer temperatures, trapping dust and reducing noise. 2. (trees) Provide nesting and cover areas for birds and squirrels. 3. (trees) Stabilize soil, screen unsightly areas, enhance visual quality of residential and commercial areas.

[1]50 years @ 5 7/8 percent.

REGIONAL DEVELOPMENT ACCOUNT

Components	Measures of Effects (Average Annual)[1]	
	Region	Rest of Nation
Beneficial Effects:		
A. The value of increased output of goods and services to users residing in the region.		
1. Additional wages and salaries.	$50,000	$-50,000
Adverse Effects:		
Technical Assistance Cost.	--	50,000

SOCIAL WELL-BEING ACCOUNT

Components	Measures of Effects
C. Recreational opportunities.	1. Provide opportunity for region urban residents to enjoy the natural scenic, and aesthetic values of trees.

RECOMMENDATION 5--Accelerate the land treatment program on 8,200 acres of commercial forest land in Subarea 1 to bring this land into full timber production.

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measures of Effects (Average Annual)[1]
Beneficial Effects:	
A. The value to users of increased outputs of goods and services.	
1. Long-term increase in timber production on 8,200 acres of forest land--123,000 cubic feet each year.	Not Available
Adverse Effects:	
A. The value of resources required for a plan.	
1. Installation Cost.	$14,900
2. Technical Assistance.	12,500
Net Beneficial Effects:	Not Determined

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measures of Effects
Beneficial and Adverse Effects:	
C. Biological resources and selected ecosystems.	1. Reduce wildlife food and cover in maturing timber stands. 2. Provide excellent wildlife food and cover for 1-10 years in harvested areas. 3. Disrupt visual quality in harvested areas. 4. Increase fire hazard in harvested areas for up to 5 years.

REGIONAL DEVELOPMENT ACCOUNT

Components	Measures of Effects (Average Annual)[1]	
	Region	Rest of Nation
Beneficial Effects:		
A. The value of increased output of goods and services to users residing in the region.		
1. Long-term increase in timber production on 8,200 acres of forest land--123,000 cubic feet each year.		Not Determined
2. Additional wages and salaries from application of land treatment measures.	$6,200	$-6,200
Adverse Effects:		
A. The value of resources contributed from within the region to achieve the outputs.		
1. Installation Cost	14,900	--
2. Technical Assistance	--	12,500

SOCIAL WELL-BEING ACCOUNT

Beneficial and Adverse Effects:	Not Determined

[1]50 years @ 5 7/8 percent.

RECOMMENDATION 9--Amend or adopt flood plain zoning ordinances, building codes, and similar land use control devices in 27 existing and potential flood problem locations.

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measures of Effects (Average Annual)[1]
Beneficial Effects:	
A. The value to users of increased outputs of goods and services.	
1. Flood damage prevention to future properties.	$3,820,000
Adverse Effects:	
A. The value to resources required for a plan.	
1. Flood hazard analysis on 183 stream miles.	22,800
2. Administration of flood plain ordinances and inspection.	12,400
Net Beneficial Effects:	3,784,800

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measures of Effects
Beneficial and Adverse Effects:	
A. Areas of natural beauty.	1. Protect 183 miles of stream fisheries from pollution; high runoff, and channel bank disturbances associated with urban development. 2. Protect 15,000 acres of forest land, cropland and grassland wildlife habitat. 3. Protect the visual quality of 183 miles of stream and 15,000 acres of land.

[1]50 years @ 5 7/8 percent.

REGIONAL DEVELOPMENT ACCOUNT

Components	Measures of Effects (Average Annual)[1]	
	Region	Rest of Nation
Beneficial Effects:		
A. The value of increased output of goods and services to users residing in the region.		
1. Prevent damages to properties that will be built on the flood plain without a plan.	$3,820,000	$ --
2. Additional wages and salaries accruing to the region from implementation of the plan.	24,600	-24,600
Adverse Effects:		
A. The value of resources contributed from within the region to achieve the outputs.		
1. Flood hazard analysis on 183 stream miles.	--	22,800
2. Administration of flood plain ordinances and inspection.	12,400	--
Net Beneficial Effects:	3,832,200	-47,400

SOCIAL WELL-BEING ACCOUNT

Beneficial and Adverse Effects:	Not Determined

RECOMMENDATION 10(1)--1. North Branch Clinton River Watershed project for prevention of flood damages in a developing urban area and to agriculture.

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measures of Effects (Average Annual)[1]
Beneficial Effects:	
A. The value to users of increased output of goods and services.	
1. Flood prevention to developing urban land	$907,000
2. Agricultural flood prevention.	155,000
3. Agricultural drainage.	77,000
Adverse Effects:	
1. Floodwater retarding structures, diversions and flood prevention channel improvement.	
Installation	447,300
Land Rights	274,600
OM&R	13,900
Net Beneficial Effects:	403,200

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measures of Effects
B. Quality considerations of water, land, and air resources.	1. Reduce flooding on 6,700 acres of cropland, 400 acres of pasture, and 800 acres of forest land. 2. Add 120 acres of permanent grass land wildlife habitat. 3. Convert 100 acres of forest and brush to grass and modified channel.

REGIONAL DEVELOPMENT ACCOUNT

Components	Measures of Effects (Average Annual)[1] Region	Rest of Nation
Beneficial Effects:		
A. The value of increased output of goods and services to users residing in the region.		
1. Prevention of damages to existing and future properties in the urbanizing flood plain.	$907,000	--
2. Agricultural flood prevention.	155,000	--
3. Drainage.	155,000	-78,000
4. Additional wages and salaries accruing to the region from implementation of the plan.	94,000	-94,000
Adverse Effects:		
A. The value of resources contributed from within the region to achieve the outputs.		
1. Floodwater retarding structures, diversions and channels.		
2. Installation.	51,000	396,300
3. Land Rights	274,000	--
4. OM&R	13,900	--
Net Beneficial Effects:	971,500	-568,300

SOCIAL WELL-BEING ACCOUNT

Components	Measures of Effects
Beneficial and Adverse Effects:	
A. Real income distribution.	1. Create 70 low income jobs during construction. 2. Create regional income benefit distribution of $403,600 by income class[2] as follows: I-5%; II-33%; III-67%. 3. Local cost to be borne by region total $182,500 with distribution by income class as follows: I-5%; II-33%; 1II-67%.

[1] 50 years @ 5 7/8 percent.
[2] Classes by adjusted gross income; Class I=less than $3,000; Class II=$3,000 to $10,000; Class III=more than $10,000.

RECOMMENDATION 10(2)--Enlarge the outlet channel in Elk Creek Watershed

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measures of Effects (Average Annual)[1]
Beneficial Effects:	
A. The value to users of increased output of goods and services.	
1. Agricultural flood prevention.	$457,000
2. Agricultural drainage.	228,000
Adverse Effects:	
A. The value of resources required for a plan.	
1. Multiple purpose channel work.	
Installation	465,400
Land Rights	88,400
OM&R	45,900
Net Beneficial Effects:	85,300

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measures of Effects
Beneficial and Adverse Effects:	
B. Quality considerations of water, land, and air resources.	1. Reduce flooding on 21,750 acres of cropland, 500 acres of pasture, and 1,570 acres of forest land. 2. Reduce bank erosion on 83 miles of stream. 3. Reduce flooding on 6 bridges.
C. Biological resources and selected ecosystems.	1. Disrupt the aquatic ecosystem in 83 miles of stream. 2. Add 510 acres of permanent grassland wildlife habitat.
D. Irreversible or irretrievable commitments of resources.	1. Convert 473 acres of forest and brush land to grass or modified channel.

REGIONAL DEVELOPMENT ACCOUNT

Components	Measures of Effects (Average Annual)[1] Region	Rest of Nation
Beneficial Effects:		
A. The value of increased output of goods and services to users residing in the region.		
1. Agricultural flood prevention.	$457,000	--
2. Agricultural drainage.	457,000	-229,000
3. Additional wages and salaries accruing to the region from implementation of the plan.	157,200	-157,200
Adverse Effects:		
A. The value of resources contributed from within the region to achieve the outputs.		
1. Multiple purpose channel work.		
Installation	139,700	325,700
Land Rights	88,410	--
OM&R	45,900	--
Net Beneficial Effects:	797,190	-711,900

SOCIAL WELL-BEING ACCOUNT

Components	Measures of Effects
Beneficial and Adverse Effects:	
A. Real income distribution.	1. Create 151 low to medium income jobs for one year. 2. Create 5 permanent seasonal jobs for low to medium income workers. 3. Create regional income benefits distribution of $1,071,300 by income Class[2] as follows: Class I-5%; Class II-33%; Class III-67%. 4. Local cost to be borne by region totals $3,197,800 with distribution by income class as follows: Class I-5%; Class II-33%; Class III-67%.

[1]50 years @ 5 7/8 percent.
[2]Income Class ($)I, less than $3,000; II, $3,000 to $10,000; III, more than $10,000.

RECOMMENDATION 10(3)--Enlarge the outlet channel for Upper Belle River Watershed

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measures of Effects (Average Annual)[1]
Beneficial Effects:	
A. The value of users of increased output of goods and services.	
1. Agricultural flood prevention.	$105,000
2. Agricultural drainage.	52,000
Adverse Effects:	
A. The value of resources required.	
1. Multiple purpose channel work.	
Installation	22,890
Land Rights	13,760
OM&R	2,300
Net Beneficial Effects:	118,050

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measures of Effects
Beneficial and Adverse Effects:	
B. Quality considerations of land, water, and air resources.	1. Reduce flooding on 1,370 acres of cropland and 185 acres of forest land. 2. Reduce flooding on 4 bridges. 3. Reduce bank erosion on 7.5 miles of stream.
C. Biological resources and selected ecosystems.	1. Disrupt the aquatic ecosystem on 7.5 miles of stream. 2. Add 60 acres of permanent wildlife habitat.
D. Irreversible or irretrievable commitments of resources.	1. Convert 20 acres of forest land and brush wildlife habitat to grass and modified channel.

[1]50 years @ 5 7/8 percent.
[2]Income classes (adjusted gross income) are as follows: Class I, less than $3,000; Class II, $3,000 to $10,000; Class III, more than $10,000.

REGIONAL DEVELOPMENT ACCOUNT

Components	Measures of Effects (Average Annual)[1]	
	Region	Rest of Nation
Beneficial Effects:		
A. The value of increased output of goods and services to users residing in the region.		
1. Agricultural flood prevention.	$105,000	--
2. Agricultural drainage.	105,000	-53,000
3. Additional wages and salaries accruing to the region from implementation of the plan.	7,410	-7,410
Adverse Effects:		
A. The value of resources contributed from within the region to achieve the outputs.		
1. Multiple purpose channel work.		
Installation	7,360	15,530
Land Rights	13,760	--
OM&R	2,300	--
Net Beneficial Effects:	193,990	75,940

SOCIAL WELL-BEING ACCOUNT

Components	Measures of Effects
Beneficial and Adverse Effects:	
A. Real income distribution.	1. Create 6.6 low to medium to low income jobs for one year. 2. Create .5 low to medium income permanent seasonal jobs. 3. Create regional income benefit distribution of 217,410 by income classes as follows: Class I-5%; Class II-33%; Class III-67%.[2] 4. Local cost to be borne by the region total $338,700 with distribution by income class as follows: Class I-5%; II-33%; Class III-67%.

RECOMMENDATION 10(4)--Enlarge outlet channel in Tupper Brook Watershed

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measures of Effects (Average Annual)[1]
Beneficial Effects:	
A. The value to users of increased output of goods and services.	
1. Agricultural flood prevention.	$24,600
Adverse Effects:	
A. The value of resources required for a plan.	
1. Multiple purpose channel work.	
Installation	23,690
Land Rights	4,940
OM&R	6,860
Net Beneficial Effects:	-10,890

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measures of Effects
Beneficial and Adverse Effects:	
B. Quality considerations of water, land, and air resources.	1. Reduce flooding on 3,100 acres of cropland, 250 acres of pasture, and 450 acres of forest land. 2. Reduce erosion on 14.3 miles of stream. 3. Reduce flooding on 3 bridges.
C. Biological resources and selected ecosystems.	1. Disrupt the aquatic ecosystem on 14.3 miles of stream. 2. Add 120 acres of permanent grassland wildlife habitat.
D. Irreversible or irretrievable commitments of resources.	1. Convert 40 acres of forest and brush to grass and modified channel.

REGIONAL DEVELOPMENT ACCOUNT

Components	Measures of Effects (Average Annual)[1] Region	Rest of Nation
Beneficial Effects:		
A. The value of increased output of goods and services to users residing in the region.		
1. Agricultural flood prevention.	$24,600	--
2. Agricultural drainage.	24,600	-24,600
3. Additional wages and salaries accruing to the region from implementation of the plan.	16,300	-16,300
Adverse Effects:		
A. The value of resources contributed from within the region to achieve the outputs.		
1. Multiple purpose channel work.		
Installation	6,900	16,790
Easements	4,940	--
OM&R	6,860	--
Net Beneficial Effects:	46,800	57,690

SOCIAL WELL-BEING ACCOUNT

Components	Measures of Effects
Beneficial and Adverse Effects:	
A. Real income distribution.	1. Create 8 low to medium income jobs for one year. 2. Create regional income benefit distribution of $65,400 by income Class[2] as follows: Class I-5%; Class II-33%; Class III-67%. 3. Local cost to be borne by region total $182,500 with distribution by income class as follows: I-5%; II-33%; III-67%.

[1] 50 years @ 5 7/8 percent.

[2] Income classes (adjusted gross income) are as follows: Class I, less than $3,000; Class II, $3,000 to $10,000; Class III, more than $10,000.

RECOMMENDATION 10(5)--Install individual farm drainage pump outlets in the Otter Creek Watershed.

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measures of Effects (Average Annual)[1]
Beneficial Effects:	
A. The value to users of increased output of goods and services.	
1. Efficiency gains.	$21,000
Adverse Effects:	
A. The value of resources required for a plan.	
1. Pumps and outlets channels.	
Installation	6,340
Land Rights	0
OM&R	8,100
Net Beneficial Effects:	6,560

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measures of Effects
Beneficial and Adverse Effects:	
B. Quality considerations of water, land, and air resources.	1. Reduce flooding on 2,190 acres of cropland, 30 acres of pasture and 300 acres of forest.
C. Biological resources and selected ecosystems.	1. Not determined.
D. Irreversible or irretrievable commitments of resources.	1. None.

REGIONAL DEVELOPMENT ACCOUNT

Components	Measures of Effects (Average Annual)[1]	
	Region	Rest of Nation
Beneficial Effects:		
A. The value of increased output of goods and services to users residing in the region.		
1. Drainage benefits to agriculture.	$43,000	$-22,000
2. Additional wages and salaries accruing to the region from implementation of the plan.	13,500	-13,500
Adverse Effects:		
A. The value of resources contributed from within the region to achieve the outputs.		
1. Drainage pumps and outlets.		
Installation	6,340	--
Easements	0	--
OM&R	8,100	--
Net Beneficial Effects:	42,060	35,500

SOCIAL WELL-BEING ACCOUNT

Components	Measures of Effects
Beneficial and Adverse Effects:	
A. Real income distribution:	1. Create 1.0 low to medium income jobs. 2. Create regional income benefit distribution of $49,400 by income class as follows: Class I-5%; Class II-33%; Class III-67%. 3. Local cost to be borne by region total $101,600 will be shared in the same proportion as benefits derived.

[1] 50 years @ 5 7/8 percent.

RECOMMENDATION 12--Accelerated land treatment program on 80,000 acres of moderate to highly erosive soils currently in rowcrops in Subareas 4 and 5.

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measures of Effects (Average Annual)[1]
Beneficial Effects:	Not Determined
Adverse Effects:	
A. The value of resources required for a plan.	
1. Annual Installation Cost.	$81,000
2. Technical Assistance Cost.	21,800

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measures of Effects
Beneficial and Adverse Effects:	
B. Quality considerations of water, land, and air resources.	1. Reduce erosion and sedimentation on 80,000 acres of cropland. 2. Improve water quality by reducing erosion and sedimentation by increasing infiltration and reducing storm runoff. 3. Decrease agricultural nutrient contribution to streams.

REGIONAL DEVELOPMENT ACCOUNT

Components	Measures of Effects (Average Annual)[1]	
	Region	Rest of Nation
Beneficial Effects:		
A. The value of increased output of goods and services to users residing in the region.		
1. Additional wages and salaries from installation, engineering, and administration.	$57,400	-57,400
Adverse Effects:		
A. The value of resources contributed from within the region to achieve the outputs.		
1. Installation cost of treatment measures.	81,000	--
2. Technical Assistance Cost.	--	21,800

SOCIAL WELL-BEING ACCOUNT

Beneficial and Adverse Effects:	Not Determined

[1] 50 years @ 5 7/8 percent.

RECOMMENDATION 13--Enforce the Soil Erosion and Sediment Control Act of 1972 to reduce erosion or urban construction sites.

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measures of Effects (Average Annual) [1]
Beneficial Effects:	Not Determined
Adverse Effects:	
A. The value of resources required for a plan.	
1. Annual Installation Cost.	$9,300,000
2. Engineering and Administrative Cost.	930,000

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measures of Effects
Beneficial and Adverse Effects:	
B. Quality considerations of water, land, and air resources.	1. Annually reduce erosion on approximately 15,000 acres by up to 60 tons per acre. Total reduction up to 900,000 tons. 2. Improve water quality by reducing erosion, sedimentation, and storm runoff.

[1] 50 years @ 5 7/8 percent.

REGIONAL DEVELOPMENT ACCOUNT

Components	Measures of Effects (Average Annual) [1]	
	Region	Rest of Nation
Beneficial Effects:		
A. The value of increased output of goods and services to users residing in the region.		
1. Additional wages and salaries from installation and administration.	$5,000,000	$-5,000,000
Adverse Effects:		
A. The value of resources contributed from within the region to achieve the outputs		
1. Annual Installation Cost.	9,300,000	--
2. Engineering & Administration.	465,000	465,000

SOCIAL WELL-BEING ACCOUNT

Beneficial and Adverse Effects:	Not Determined

APPENDIX C

FORESTRY DATA

TABLE C-1--Commercial Forest Land by Forest Type

Sub-Area	All Types	Softwood			Hardwood				
		Total	Pine	Spruce Fir	Total	Oak-Hickory	Elm-Ash Cottonwood	Maple-Beech White Birch	Aspen-Birch
		1,000 Acres							
1	129.0	5.9	3.0	2.9	123.1	35.1	22.3	26.6	39.1
2	55.1	9.8	5.5	4.3	45.3	22.1	--	12.3	10.9
3	57.8	7.9	4.0	3.9	49.9	13.0	5.0	14.6	17.3
4	132.1	16.6	8.4	8.2	115.5	50.1	18.0	28.3	19.1
5	148.2	10.9	7.4	3.5	137.3	80.1	11.2	28.2	17.8
TOTAL	522.2	51.1	28.3	22.8	471.1	200.4	56.5	110.0	104.2

TABLE C-2--Commercial Forest Land by Stocking Class

Sub-Area	Total	Stocking Classes		
		+40 Percent	40-10 Percent	Less than 10 Percent
		1,000 Acres		
1	129.0	77.4	37.4	14.2
2	55.1	32.5	16.5	6.1
3	57.8	36.4	16.8	4.6
4	132.1	77.9	39.6	14.6
5	148.2	87.4	44.5	16.3
TOTAL	522.2	311.6	154.8	55.8

TABLE C-3--Ownership of Forest Land

Sub-Area	Public				Private
	Total	Federal	State	Other Public	Farmer Owned & Misc. Private
	------1,000 Acres-------				
1	130.1	.1	5.9	.3	123.8
2	74.0	--	12.2	11.5	50.3
3	59.4	--	.7	.6	58.1
4	133.1	--	3.9	.4	128.8
5	150.0	.1	12.6	1.7	135.7
TOTAL	546.6	.1	35.6	14.7	496.7

TABLE C-4--Forest Land Suitability Categories by Subareas[1] (Thousand Acres)

Subarea	Suitability Categories 1	2	3	4	5
1	36.9 (4%)	45.6 (6%)	549.0 (68%)	37.8 (5%)	135.8 (17%)
2	74.7 (22%)	81.5 (24%)	174.8 (51%)	7.8 (2%)	3.9 (1%)
3	64.9 (41%)	-0- -0-	74.6 (47%)	19.4 (12%)	-0- -0-
4	95.1 (10%)	122.2 (13%)	565.6 (59%)	107.7 (11%)	69.8 (7%)
5	32.6 (6%)	112.6 (22%)	264.9 (53%)	55.7 (11%)	42.5 (8%)
TOTALS	304.6	361.9	1628.9	228.4	252.0

[1]Existing urban areas excluded.

FOREST LAND SUITABILITY CATEGORIES

Category 1--Soils in this category are suitable for commercial timber production. Ancillary management objectives would be for recreation and wildlife habitat.

Plant competition following removal of the overstory can be moderate, and undesirable brush and tree species may delay the establishment of a fully stocked stand. Natural regeneration is adequate with few restrictions to tree growth or logging conditions. Yields from fully stocked hardwood stands average 300 board feet per acre per year (BF/acre/year). Red oak, white oak, white ash, sugar maple, walnut, and yellow poplar are desirable species. This category is on well drained loam and sandy loam soils with 3 to 12 percent slopes. Erosion potential is slight to moderate, depending upon degree and length of slope.

Category 2--The type of forested land in this category is suitable for recreational purposes. Timber production and wildlife habitat are other suggested objectives.

Factors limiting tree growth and regeneration are slight to moderate, and survival of planted or natural tree seedlings is good, particularly for coniferous species. Oak-hickory and northern hardwood species are predominant. Favorable species for establishment are sugar maple, red oak, basswood, and red pine. Annual yields of 200 BF/acre/year can be expected for hardwoods and 240 to 300 BF/acre/year for pine. Well drained sands and loamy sands with low to medium moisture-holding capacity and fertility are characteristic of this category. Slopes are predominantly 3 to 12 percent, however, some slopes are greater. Erosion can be expected on slopes over 18 percent when the soil is disturbed.

Category 3--Due to high water table conditions, the type of forest land found in this category is most suitable for environmental enhancement, open space, and greenbelts. A suggested secondary use would be wildlife habitat.

A high water table is predominant during wet seasons of the year and lowland hardwoods (white ash, aspen, and soft maple) are predominant. Plant competition is moderate to severe and hinders the establishment of fully stocked stands. Afforestation should not be encouraged on undrained soils due to the high mortality caused by excessive water. Hardwood yields are low and windthrow does occur because of equipment restriction caused by high water levels or excessive soil moisture. This category is on poorly drained loams and sandy loams with 0 to 3 percent slopes. Moisture-holding capacity and fertility levels are moderate to high. Erosion is not considered a problem.

Category 4--Forest land in this category is suitable for upland wildlife habitat, aesthetics, and open space.

A high water table, moderate moisture-holding capacity, and fertility levels are characteristic of soils in this category. Low yields can be expected, with less than 150 BF/acre/year for hardwood stands. Most favorable species for this category are white ash, soft maple, cottonwood, basswood, and swamp white-oak. Windthrow is moderate to severe, as is competition from brush and other vegetation. Reforestation and afforestation should not be encouraged. Seasonal restrictions on logging due to high water tables and excessive soil moisture can be expected. Erosion hazard is slight.

Category 5--Forest land in this category is poorly drained and therefore suitable for wetland wildlife habitat, aesthetics, and environment enhancement.

This category is not considered appropriate for the growing of commercial trees because of the excessive water and severe plant competition.

Lowland hardwoods are the predominant timber types. Windthrow is a problem and logging equipment will be restricted to the drier seasons or frozen ground. The erosion hazard is slight.

NATIONAL CHAMPION TREES

1. American Bladdernut, Stophlea trifolic
   Circumference (1'7") Height (36') Spread (37')
   Near Utica, Macomb County
2. Boxelder, Acer negundo
   (16'6") (95') (101')
   Washtenaw County
3. European Buckthorn, Thamnus cathartica
   (3'9") (61') (65')
   Ann Arbor, Washtenaw County
4. Common Buttonbush, Cephalanthus occidentalis
   (2'2") (29') (17')
   Near Clinton, Washtenaw County
5. Cockspur Hawthorn, Crataegus punctata
   (6'2") (27') (37')
   Near Orrville, Wayne County
6. Dotted Hawthorn, Crataegus punctata
   (4'2") (38') (54')
   Bloomfield Hills, Oakland County
7. Downy Hawthorn, Crataegus mollis
   (8'9") (52') (62')
   Grosse Ile, Wayne County
8. Honey Locust, Gleditsia triacanthos
   (17') (115') (124')
   Grosse Ile, Wayne County
9. Black Maple, Acer nigrum
   (14'6") (110') (108')
   Oakland County
10. Red Maple, Acer rubrum, var. rubrum
    (16'3") (125') (108')
    Armada, Macomb County
11. Silver Maple, Acer saccharinum
    (22'7") (125') (108')
    Rochester, Oakland County

12. Bur Oak, Quercus macrocarpa
(20'11") (128') (104')
Algonac, St. Clair County
13. Northern Pin Oak, Quercus ellipsoidalis
(Co-champion)
(11'5") (85') (86')
Oakland County
14. Schuette Oak, Quercus Xschuetti
(Hybrid Q. bicolor x Q. macrocarpa)
(18'9") (114') (120')
Near Rochester, Oakland County
15. Pear, Pyrus communis
(Co-champion)
(11'4") (51') (50')
Clawson, Oakland County
16. Scotch Pine, Pinus sylvestris
(14'9") (63') (75')
Lenawee County
17. American Plum, Prunus americana
(3') (35') (35')
Near Lakeville, Oakland County
18. Canada Plum, Prunus nigra
(4'2") (51') (48')
Near Utica, Macomb County
19. Staghorn Sumac, Rhus typhinia
(2'3") (49') (30')
Orchard Lake, Oakland County
20. Crack Willow, Salix fragilis
(24'10") (112') (116')
Near Utica, Macomb County
21. Sandbar Willow, Salix interior
(1'8") (37') (13')
Near Utica, Macomb County
22. Weeping Willow, Salix babylonica
(20'9") (106') (114')
Detroit, Michigan
23. White Willow, Salix alba, var. vitellina
(28'7") (83') (132')
Jackson County
24. Witchhazel, Hamamelis virginiana
(1'1") (44') (34')
Franklin, Oakland County

APPENDIX D

National Register of Historic Places*

Lenawee County

Adrian, *Civil War Memorial*, Monument Park.
Adrian, *Croswell, Governor Charles, House*, 223 North Broad Street.
Blissfield, *First Presbyterian Church of Blissfield*, 306 Franklin Street.
Cambridge Junction, *Walker Tavern* (*Cambridge State Historical Park*), on U.S. 12.
Tecumseh, *Evans, Musgrove, House*, 409–411 East Logan Street.

Livingston County

Brighton, *Bingham House*, 10950 McCabe Road.
Rushton vicinity, *Olds, Alonzo W., House*, 10084 Rushton Road.

Macomb County

Romeo, *Romeo Historic District*, bounded on the north by Gates Street, running east and west 2,700 feet north of St. Clair Street; bounded on the south by Durham Drive and a line running east and west 3,180 feet south of St. Clair Street; the western boundary runs north and south 2,940 feet from Main Street; the eastern boundary is 2,400 feet from Main Street.
Sterling Township, *Holcombe Site*, SW¼ SW¼ sec. 23, T. 2 N., R. 12 E.
Utica vicinity, *Clinton-Kalamazoo Canal* (also in Oakland County).
Washington, *Washington Octagon House*, 5763 Van Dyke.

Monroe County

Monroe, *Fix House*, Sterling State Park.
Monroe, *McClelland, Governor Robert, House*, 47 East Elm.
Monroe, *Nims, Rudolph, House*, 206 West Noble Avenue.
Monroe vicinity, *Havarre-Anderson Trading Post*, North Custer Road at Raisinville Road.

Oakland County

Birmingham, *Hunter, John W., House*, 556 West Maple.
Clinton-Kalamazoo Canal (see Macomb County).
Franklin, *Village of Franklin Historic District*, bounded approximately by the Franklin River and properties fronting on Bowden Street, by Romany Way and Scenic Highway, properties fronting on Franklin Road, and a line extending about 300 feet north of and parallel to Fourteen Mile Road.
Pontiac, *Myrick-Palmer House*, 223 West Huron Street.
Pontiac, *Wisner House* (*Pine Grove*), 405 Oakland Avenue.
Rochester vicinity, *Stony Creek Village Historic District*, northeast of Rochester on Washington Road.
Troy, *Brooks Farm*, 3521 Big Beaver Road.
Troy, *Caswell House*, 60 West Wattles Road.

St. Clair County

Marine City, *Ward-Holland House*, 433 North Main Street.
Port Huron, *Davidson, W. F., House*, 1707 Military Street.
Port Huron, *St. Clair River Tunnel*, St. Clair River between Port Huron, Mich., and Sarnia, Ontario.

Washtenaw County

Ann Arbor, *Ann Arbor Central Fire Station*, corner of Fifth Avenue and Huron Street.
Ann Arbor, *Frieze, Henry S., House*, 1547 Washtenaw Lane.
Ann Arbor, *Judge Wilson House*, 126 North Division Street.
Ann Arbor, *Newberry Hall* (*Francis W. Kelsey Museum of Archeology*), 434 South State Street, University of Michigan campus.
Ann Arbor, *Old West Side Historic District*, bounded on the north by West Huron Street, on the east by the Ann Arbor Railroad tracks and South Main Street, on the south by Pauline Boulevard and Madison Street, and on the west by South Seventh Street and Crest Avenue.
Ann Arbor, *President's House, University of Michigan*, 815 South University, University of Michigan campus.
Ann Arbor, *Ticknor, Benejah, House*, 2781 Packard Road.
Ann Arbor, *White, Orrin, House* (*Robert Hodges Residence*), 2940 Fuller Road.
Dexter, Gordon Hall (*Judge Samuel W. Dexter House*), 8347 Island Lake Road.
Dixboro, *Dixboro United Methodist Church*, 5221 Church Street.
Ypsilanti, *Davis, William M., House*, 218 North Washington Street.

Wayne County

Dearborn, *Commandant's Quarters*, 21950 Michigan Avenue.
Dearborn, *Fair Lane* (*Henry Ford Estate*), 4901 Evergreen Road.
Dearborn, *Greenfield Village*, Oakwood Boulevard.
Detroit, *Bagley Memorial Fountain*, Woodward and Monroe Avenues.
Detroit, *Christ Church, Detroit*, 960 East Jefferson Avenue.
Detroit, *Fort Street Presbyterian Church*, 631 West Fort Street.
Detroit, *Fort Wayne*, 6053 West Jefferson Avenue.
Detroit, *Freer, Charles Lang, House* (*Merrill-Palmer Institute of Human Development and Family Life*), 71 East Ferry Street.
Detroit, *Hecker, Colonel Frank J., House*, 5510 Woodward Avenue.
Detroit, *Indian Village Historic District*, bounded by Mack, Burns, Jefferson, and Seminole Avenues.
Detroit, *Kahn, Albert, House*, 208 Mack Avenue.
Detroit, *Mariners' Church*, 170 East Jefferson Avenue.
Detroit, *Moross House*, 1460 East Jefferson.
Detroit, *Orchestra Hall*, 3711 Woodward Avenue.
Detroit, *Pewabic Pottery*, 10125 East Jefferson Avenue.
Detroit, *St. Joseph's Roman Catholic Church*, 1828 Jay Street.
Detroit, *SS. Peter and Paul Church* (*Roman Catholic*), 629 East Jefferson Avenue.
Detroit, *Sibley House*, 976 East Jefferson Avenue.
Detroit, *West Canfield Historic District*, Canfield Avenue between Second and Third Streets.
Detroit, *Whitney, David, House*, 4421 Woodward Avenue.
Grosse Ile, *St. James Episcopal Chapel*, 25150 East River Road.
Grosse Pointe Farms, *Dodge Mansion* (*Rose Terrace*), 12 Lakeshore Drive.
Livonia, *Greenmead Farms* (*Simmons*, 38125 Base Line Road.
Northville, *Northville Historic District*.

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